Multimodal Representation and the Making of Knowledge:
A social semiotic excavation of learning sites

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A thesis submitted for the degree of Doctor of Philosophy

(PhD)

January 2006

ABSTRACT

This research is concerned with the construction of knowledge as evidenced in the multimodal representations of students. In the spirit of an archaeological excavation it seeks to uncover evidence of that which can not be seen; of learning. It provides systematic classification and analysis of multimodal texts retrieved from secondary school science and history lessons. By conducting this analysis and accounting for the conditions of representation that stimulate learning it also demonstrates the instrumentality of representational activity in the making of knowledge.

Applying social semiotic theory to textual artefacts from the two sites, a new methodology is utilised to expose evidence of learning. This methodology is derived from theories of social semiotics (Halliday, 1978 and Hodge and Kress, 1988) and multimodality (Kress and van Leeuwen, 1996). It is based on a conception of learning as a process in which the status and identity of the individual are changed. It is informed by, amongst others, Bernstein (1996) - in relation to the socialising of individuals through systems of education and by Vygotsky (1962) - in relation to the shaping of consciousness.

The thesis consists of the description and demonstration of new methods for multimodal analysis of students' representational activity. The technique used for the presentation of data is *tracking semiosis* and for analysis *process charting* and *mode mapping*. Together these methods expose changes arising from the reconfigurations, transformations and transductions undertaken by students engaged in representational activity. In so doing, new directions are offered for the orientation of education practices in the face of rapidly changing patterns of communication. The efficacy of learning in multiple modes is also established and groundwork laid for fresh approaches to assessment.

DECLARATION

I hereby declare that, except where explicit attribution is made, the work presented in this thesis is entirely my own.

Word count (exclusive of appendices and bibliography): 79,475 words

ACKNOWLEDGEMENTS

My supervisor, Gunther Kress, has motivated and guided me sensitively throughout the research. I was also fortunate enough to have Mary Scott as a supervisor at the early stages – a great encouragement.

In carrying out my fieldwork, staff and students at Sarah Bonnell School were exceptionally cooperative. In particular I must thank Kath Partington, Kieron Burke and Tahera Ali for their willingness to become involved and their insights.

There are four students whose representational creativity is at the heart of this research. They are, without doubt, the stars of the piece: Charlene Clarke, Rachel Howe, Rumena Rahman and Sonia Nayyar.

My sister, Lois Palframan and friends, Jeremy Carroll and Jason Nicholls all contributed to the development of the research in different ways and at different stages. I am grateful for their genuine interest.

Carey Jewitt and Audrey Langill provided valuable technical advice and guidance.

Without my parents, Pauline and Gerald Palframan the work would not have got done. The have provided constant, practical support.

Of my two boys, Leon was born between the fieldwork and writing up whereas Joseph has lived with the 'theseus' for most of his life. Thank you for sharing your mum.

Finally, it has been the financial support from the ESRC which enabled me to complete this research. I am immensely grateful to have had this opportunity.

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1.1 Research Origins

The issues on which this study will focus first made themselves apparent in the activities of students in the classroom. The researcher, had, over a number of years and with different teachers and classes, been involved with an unusually popular piece of work in history. The unit of study, entitled 'Black People of the Americas' began with a focus on the ancient African civilisation of Benin – one of the teaching objectives being to promote understanding of the cultures from which African slaves were taken. The main activity of the unit – often spread over two or three weeks of lessons – required students, in groups, to create their own representations of the ancient city of Benin based on information obtained from a range of sources. On every occasion that this unit was taught, the variety of visual interpretations of the city was intriguing. Although the resource materials were the same for each group of students, no two representations created were ever the same. Each was unique. Such variety invariably prompted expressions of fascination from teachers curious as to the possible explanations for the astonishingly different interpretations. Why were some of the plans of the city three dimensional, others not? Why were some populated with figures of people? Why were some drawn on to paper and others pieced together like a collage? Why were certain materials chosen (newspaper, cotton wool, straws) and not others? What lay behind the symbolism and choice of images? What thinking had gone into the layout? What were these representations evidence of and what did they reveal about the students' orientation towards the world around them? In short, what learning were they evidence of?

It could also be seen that students engaged in this work with great enthusiasm; that it absorbed their attention and that their physical handling of the materials seemed to open up new ways of thinking about the information. The talk they engaged in while doing the material work for their representations revealed something of how their understanding developed. Subsequent presentations to classmates provided further indications of a relationship between engagement in the task of representation and the learning itself. To explore this relationship – hitherto interesting yet inexplicable –

and to try to systematically catalogue and describe its features presented a clear challenge.

1.2 A Snapshot of the Issue

The following snapshot of students at work on their Benin City plan illustrates how, in the classroom, the relationship between representational activity and learning put itself forward, rather forcefully, for consideration.

During a year nine history lesson, period one on a Thursday morning a group of students carrying out the task set by their teacher runs into a problem. The task is to create a representation – a bird's eye view – of the ancient city of Benin based on the resource materials studied in an earlier lesson. Throughout their discussion, one particular question keeps recurring in the students' conversation as they sit around their table looking down at the large sheet of paper which is to become their 'Benin City'. 'Nine gateways', reads student A from her notes. Student D starts counting: 'One, two, three, four, five…' . 'Is it to the castle or to the whole..?' student A begins to ask. She is interrupted by D: 'It didn't say'. There is a pause lasting several seconds while the students look at each other and at the paper in front of them. 'So what should we do then?' B asks.

Several minutes later, the matter is still unresolved. Student A repeats the question 'So what should we do then?' With pressure to complete the plan increasing, she takes the step of narrowing the possibilities: 'We have to make sure if it's for the king's court or the whole city'. D looks around for her sheet of notes to help establish the facts. C who has crumpled up the paper in frustration, passes the ball to D who smoothes it flat on the table. Seeking clarification, B speaks up: 'Wait a minute. Did you say nine gateways?'. 'Yeah,' replies D. 'That's really what she got. So it's really based on what WE get'. Student B, eager to comply with the teacher's instructions to base the plan only on information obtained from the resources speaks with confidence. Student C, however, is not happy: 'Ugh', she says, 'so we should just do nine gateways'. But there is no way of *just doing* the gateways. Student A is frustrated: 'Yeah but WHERE, I'm saying WHERE?'. There is a further pause while D re-reads the crumpled sheet of notes. A stares at the sheet on the table and C taps her pen. D then spots an item of information that could provide a possible reason for

positioning the gates in one place rather than another. 'Powerful charms', she reads, 'there was powerful charms underneath the nine gateways that stopped evil spirits'. After a brief exchange with the teacher who reiterates the need to base decisions on their own evidence, a breakthrough is made: 'They're trying to look after the king. They're trying to look after the king and queen so it must have been for that palace.' And so the matter of positioning the gates is resolved and the group moves on with their representation.

This snapshot demonstrates how the students were compelled by the task of representation to grapple with their understanding of the function of the gates. Precisely because it was so difficult for them, this incident highlights the range of factors at issue when learners are required to reason their way out of an impasse; when they learn. It demonstrates how the activity of representation necessarily incurs the making of choices. In this case decisions had to be reached about how many gates should appear, and where they should be positioned. Also, although it was not discussed, someone had to decide what features the gates would need to have to make them recognisable as gates. The task of creating a visual representation required a range of decisions to be made. Some can be traced in the students' dialogue, others are apparent only in the final visual text. In the case cited above the gates appear as gaps in a thick black line which outlines the palace. This, of course, is not accidental but a deliberate choice – given the scanty evidence the gates are represented as free as possible from distinguishing features. Other groups of students, however, working from the same resources responded differently. Some drew or constructed decorative model gateposts, some made hinged doors. In the light of these differences the apparently straightforward representation of gates as gaps needs to be seen as the result of a deliberate decision – a motivated choice.

This snapshot also illustrates the part played by mode in the shaping of information for the crisis concerning the position of the gates occurs as a direct result of the move from the verbal modes (written and spoken language) to the visual. The verbal modes in which the information was presented, entailed an orientation towards the world which did not require position to be specified – existence was sufficient ('There were nine gateways'). Put the same information in to a visual mode, however, and one's knowledge of it comes into question. In the visual mode, governed by the logics of

space, everything must be positioned. Although the students were not aware of it, the switch from verbal to visual and the augmentation of information it necessitated were the cause of their problems with the gates. They could not simply transfer the information directly from one mode to another and the compulsion to reshape the information and specify position was keenly felt. There is no doubt, in this case, that the students' engagement with different representational modes played a role in shaping their knowledge.

Furthermore the snapshot shows that in extending their information to meet the requirements of the new representational mode, the students necessarily aligned themselves with a particular epistemology. That is to say, in deciding that the gates were at the entrance to the palace because they were sites of protective charms, they subscribed to a particular understanding of the culture and civilisation of Benin. The reasoning they employed to make their representational choice was a reflection of their commitment to a particular understanding of how (one element of) ancient Benin was organised. They decided that the king and queen functioned as a dual embodiment of royalty and that their subjects were responsible for their protection. The fact that they were challenged by the mode shift to express this commitment to a particular understanding brings to light the kind of epistemological commitment involved in *every* act of representation. Had the representational challenge of the gates not presented itself during their course of study, this element of their understanding may not have required formulation. The correctness of the information construed is not, at this point, in question. What is at issue is the representational means by which they come to construe their meaning and how this operates.

Lastly it should be noted that in taking this epistemological stand the students' response also raises the issue of their status as learners. The requirements of the task as set by the teacher are referred to by the students several times – the need to represent only evidence obtained from the resources. When they do reach a crisis in their decision-making they ask the teacher for guidance. What is provided, instead, is the directive from the teacher that they should act as independent thinkers and interpret the evidence as they like as long as they can justify it. While the students have a strong desire to 'get it right', the teacher is clearly anticipating a range of different interpretations. Unlike some other forms of learning this activity of

representing what they have learnt is not merely a matter of reproducing received knowledge – it requires them to go further. This is not a learning situation with which the students are familiar or particularly comfortable. Nevertheless the fact that the students are anxious about their elevation in status as knowers is significant. It is the task of representation itself that has redefined their role as learners. Of all the kinds of learning they are familiar with, the activity of representing what they know is seen here to offer students a different kind of learning experience; one which they find particularly challenging.

1.3 Positioning the Research

The phenomenon under investigation, to elaborate on what has already been stated, is the relationship between (multimodal) representation and learning. In choosing this focus, two assumptions have been made: firstly that learning and representation are indeed related and secondly that this relationship has the potential, under appropriate investigation, to yield significant insights. The design of the research, being concerned with both the invisible processes of learning as well as tangible, visible texts consequently draws on a wide range of qualitative educational research conventions. What follows is an attempt to broadly sketch out the position of this research in relation to existing conventions: to clarify what *kind* of knowledge is sought by this research and, by implication, what claims can be made on its behalf.

1.3.1 Scope and Generality

The first positioning feature of the study to be addressed is its scope. It focuses, primarily, on the texts produced by just one group of four students during two sets of lessons. It does so, however, on the understanding that the full and detailed exploration of one specific set of relationships - between one group of students and the texts they produce - is indeed a relationship from which generalisations can be made. It will also be shown that the findings offered by the research concern both individual instances of learning and the principles behind them which, it is proposed, govern relations between representation and learning more widely. There are, however, questions raised by this proposed generalisability that need to be addressed. (Clearly, this is not generalisation based on accumulative instances.) There are two propositions regarding generalisability of educational research which hold currency within the research establishment and to which this particular study can usefully make

reference. The first of these propositions is Stake's notion of *naturalistic generalisation*; a concept originating from the concern to direct researchers and evaluators to practical experience in context rather than abstract issues. Generalisations under these circumstances, Stake argues, have a particular quality:

> '... they seldom take the form of predictions but lead regularly to expectations.' (Stake, 1983, p.282)

Such generalisations are grounded in vicarious experience and tacit knowledge being shaped by the rich 'thickly described' circumstances of the localised study which offer the reader a 'surrogate experience' (Stake, 1988) on which expectations will be based. Eisner (1991) makes a similar case for *evaluative connoisseurship* from which the *thematics*, or concrete universals of the individual case evaluated are of likely interest beyond it. The notion of connoisseurship is not out of place in this research where the data consist of richly detailed accounts of texts and their contexts of production. The intention here is to offer the reader the experience of a particular way of seeing; engagement with the data thus affording a range of opportunities for generalisation. For this to succeed, the accounts must ring true and be recognisably typical. Arising, then, from its validity as vicarious (surrogate) experience and as concrete data, the investigation into the relationship between learning and multimodal representation offered here is intended to be of wider interest. As such it should be regarded as relevant to teaching and learning in other curriculum areas and with other age groups. The research will consequently invite generalisation and will propose that the principles underlying the relationship between multimodal representation and learning uncovered here may indeed constitute 'concrete universals' which can usefully inform wider contexts.

Having expressed the view that the findings of this research are intended for generalisation it is important to identify the nature of the findings on offer. Certainly the findings are not, as has already been stated, confined to the specific patterns and regularities observed in this set of research data. Although they are of great interest and value in their own right, these observations are more usefully understood as a demonstration of the tools and techniques developed for the purpose of making the relationship between multimodal representation and learning explicit. This being the case, the *findings* do not so much concern the learning of these specific students but the propositions concerning how to go about finding out how they learnt. In short, the

development of the methodology and its possible usage are being offered as *findings* in their own right. The research account – this thesis - consequently, is weighted heavily towards the development of tools and techniques: their underpinning theory, design principles and practical application.

1.3.2 Philosophical Contexts

All research has a philosophical basis. In this case, where the focus and approach are not clearly identifiable with a particular convention, it is particularly useful to explore, at least in very generally terms, that basis. This will be done by positioning the research in relation to the major philosophical traditions – a relationship which is complex and apparently contradictory. For example, although post-positivist, the research does share at least one characteristics of even this philosophical tradition; a desire for some kind of social improvement to emanate from the findings. It is genuinely believed that perspectives arising from the research, if allowed to inform educational practice, could lead to *better* teaching and learning. There is also, in line with the positivist tradition, an element of empirical measurability implied in the proposed tools and techniques. One only needs to glance over the scientific looking diagrams in Chapter VII to gain a sense of this. To this extent the research does appear to subscribe to a single version of reality albeit one which serves the purpose of producing a much wider appreciation of multiple perceptions. It should also be noted that the wholehearted engagement with the one particular version of reality necessitated by the use of these methodological tools does not preclude alternatives. What is offered, rather, is an engagement with a particular reality in order to propose plausible interpretations.

This indeed brings the positioning of the research to a more obvious place; that of the interpretivist or hermeneutical approach. The primary aim of this research is indeed to generate new understanding and perspectives and even the development of multiple perspectives. Its concern is with interpretation of meaning invested in what is apparent: features of the written, visual and embodied texts of the classroom. The context bound subjectivities of the varying texts are struggled with in order to establish coherent patterns and regularities – there is mediation; accommodation rather than denial of difference being at issue. A further characteristic of the research which aligns it firmly with the interpretivist approach is the fact that the methodology

(the tools and techniques) derived from it are explicitly informed by metatheory: the social semiotic theories of communication.

Having so firmly aligned the research with the interpretivist approach, there are nevertheless emancipatory elements in it which draw on notions of hidden truths and masked power relations more typical of critical theory. It is indeed the intention of the research to inform and thereby change practice. Engagement with theory alone is not an intended outcome. Although the scope of the study does not allow for extensive exploration of practical implementation of new perspectives afforded by the research, it is, fundamentally, a practice-driven piece of research whose findings are intended to be the impetus for change. The interpretation of texts offered by the research brings in to question the nature of the power relationships at the heart of education: the relationship between teachers and learners, between learners and their peers and between learners and the established communities of experts. In focusing on the experience of the learner, as interpreted from their texts, it seeks to uncover what has previously been unseen and in so doing seeks to transform the conditions of learning.

1.3.3 Methodological Contexts

The philosophical position of the study having thus been mapped out in relation to the major strands, it will also be useful to relate the research to some of the conventional *methods* and to identify which existing research practices have been drawn on. As with the philosophical approaches, this research, as multimodal analysis, draws on a wide and varied range of practice.

Although the understanding of *text* here embraces a number of different types of multimodal representation, the practice is nevertheless closely aligned with the kinds of context-based text analysis and deconstruction known as *discourse analysis*. The practice undertaken here and that of discourse analysis share a common assumption: the existence of analysable elements other than what is immediately apparent in the one-off text. What is sought is an understanding of the underlying social practices which shape the acts of communication and / or representation in which individuals are participants (Fairclough, 1989). In common with discourse analysis there is, in

the methodology of this research, a preoccupation with what is implicit in the text and how this reflects the social construction of its context of production.

Because it also relies heavily on transcribed dialogue, action and observations of students, the research practice undertaken bears many resemblances to ethnography. The data occurs in every-day settings, in real time. It is not staged for the purposes of the researcher and the stance taken is non-interventionist. In keeping with the practice of critical ethnography there are no claims to neutrality or transparency (Clifford and Marcus, 1986) and the research appears to seek out and give prominence to the perspectives of the students themselves (the subjects). The research, however, is emphatically not ethnography but multimodal analysis; the presence of comparable forms of data arising from a concern with them as instances of semiosis; of representation of meaning, not as lenses through which culture may be observed. Despite superficial similarities, the defining characteristics of ethnography (that it is concerned with understanding, from the perspective of the insider, a particular social or cultural scene, (Fetterman, 1989)) are redundant. There are no such competing perspectives in multimodal analysis. Nor is there any attempt to build up the kind of prolonged, repetitive and contextualised observations proposed by Spindler (1982) in his 'Criteria for a Good Ethnography of Schooling'. Although the origins of the research did indeed lie in familiarity arising from the researcher's prolonged involvement with the students concerned, data of equal value could have been drawn from a new or unfamiliar site.

As multimodal analysis, this study, as has been discussed, does make some claims to generality. This being the case, some similarities with case study practice – where issues of generalisability are more prominent - can usefully be drawn. Certainly the almost exclusive focus on the representational activity and learning of one particular group of students is evocative of the case study approach. The use of interviews to validate other data (in particular the students' written and visual representations) reinforces this position. The similarity to be noted is with instrumental types of cases where the intention is to refine theory and gain insight into the phenomenon at issue (Stake, 1983). In this case the phenomenon is the relationship between multimodal representation and learning and the case focused upon the representational activity of one group of students. Importantly, this 'case'; these instances of representational

activity, are understood to embody phenomena typical of the relationship between representation and learning in general.

1.4 A Glance Towards Archaeology

Use of the term 'excavation' in the thesis title is not incidental. The evoking of archaeology is deliberate for there is much to be gained from approaching the task of evidence gathering and interpretation at hand with the kind of practical, systematic approach to uncovering hidden realities that the science of archaeology embodies. Without wishing to exercise the analogy beyond its limits, a brief explanation is offered here of how an archaeological mindset can, it is believed, concentrate and invigorate the task of uncovering evidence of learning in multimodal texts.

The archaeologist casts an eye over an apparently unexceptional landscape and asks the question 'What am I seeing?'. Every landscape is, of course unique – the result of a one-off set of geographical and historical circumstances. It is the work of the archaeologist to expose the qualities and features that in each case are exceptional and thereby to make plausible propositions about actual circumstances and events. What the archaeologist quite rightly anticipates finding are material objects which bear witness to another, hidden reality – those events of the past which have brought the current landscape in to being; which have shaped it. Consider, in a similar way, the classroom as a *semiotic* landscape – where the conventions and practices of meaning making between students, teachers and their (multimodal) texts are both conventionally patterned and uniquely realised – and the usefulness of seeing things differently is striking. To approach the familiar landscape of the classroom – like an archaeologist - with 'unfamiliar' eyes is indeed an excellent starting point. In the archaeologist's world instances of builders, farmers or householders overlooking priceless artefacts in the ground are well known. In classrooms equivalent items of great value and importance are regularly overlooked. They are not of the same currency as those valued by the dominant institutions; the school and curriculum. The work here, then, is to uncover the semiotic artefacts of the classroom and instate them as evidence of that hidden reality - of learning. This will be done with an awareness that, as a consequence, the currency (or value systems) of the institutions of education are themselves being brought in to question.

1.4.1 Mapping the Site

In archaeology, digging is done systematically and at carefully selected sites. Both aerial photographs and fieldwalking notes are likely to be used to establish which areas are of greatest interest and worthy of further exploration. The bumps and hollows mapped by the fieldwalker may be used alongside records of shadows, soil marks and patterns of plant growth visible from the air. The archaeologist is aware that surface traces of buried features are not always obvious – only with extensive sketching, photographing, measuring and note-making can their presence be confirmed. A similarly exhaustive approach in describing the semiotic landscape reveals the presence of features of learning. Fieldnotes and records gathered in the classroom are viewed alongside video footage of the lesson – perhaps speeded up, or without sound to provide different perspectives. Here it is not bumps and hollows that are measured but irregularities of a different kind: unusual physical arrangements, sudden increases in quantity of speech, changes in communication roles etc. These, it can be said, are the surface features of students' hidden learning; sites from which evidence can most likely be drawn; sites at which the 'digging' should begin.

1.4.2 The Dig

Depending on the archaeologist's particular orientation towards their subject, techniques may either focus on revealing the vertical dimension or the horizontal. The vertical approach involves digging out chunks of earth leaving unexcavated strips where cross sections are preserved. In so doing, the horizontal view is destroyed, priority having been given to the evidence yielded by the cross section. Fortunately the semiotic landscape is not such a physical reality and can thus be excavated in any number of ways without causing its destruction. There is, however, some insight to be gained form this element of the analogy. What is at issue is not the straightforward presence of absence of a feature but evidence of a *process* at work i.e. learning. What is being sought are indicators, then, of development, change and progression in the students themselves. As such the excavation technique must be one which can show progression; which can reveal a connected sequence. Layering, then, is an important factor in choosing an appropriate technique for uncovering evidence of learning. Being able to show change is fundamental. In terms of the semiotic stuff of the classroom different dimensions can, as in archaeology, afford different layers of perspectives. For example the instances of semiosis (acts of communication or

representation) can be looked at chronologically and peeled back over time. They can also be cross-sectioned according to semiotic function so that just one strand or element of their function is followed at a time. The use of such layering techniques opens up possibilities of not only yielding a greater quantity of evidence but also of cross referencing and none of it, once recorded, need be destroyed in the process!

In order to formulate credible descriptions of the past – the hidden reality – the archaeologist uses, with skill, a range of tools and techniques designed for the job. As has been shown, the choice of techniques and tools is likely to be determined by the particular concern of the archaeological study. Ranging from the broadly conceptual approaches (horizontal or vertical) to very specific practical techniques (stratigraphic sequencing, carbon dating, pollen analysis) the archaeologist's choice will influence considerably the validity of any subsequent claims of discovery. Any such excavation of a learning site must be subject to a similarly rigorous choice of well proven tools and techniques. Being such a new area of research it is of particular importance, in multimodal analysis, that the techniques stand up to scrutiny; that they are suited to the purpose for which their use is proposed and that they are derived from a well established theoretical base. Effective use of the latest available technology must also be made as in archaeology where scientific developments constantly inform and shape the development of techniques. It is for these reasons that considerable attention will be given to the development of techniques and tools for this study (chapter four).

1.4.3 The Finds

Because the presence of certain items can be read as evidence of events, the identification and classification of those items is, in practical archaeology, of great importance. Typological analysis is widely used. Designs, for example, on shell discs and beads from Iron Age Megalithic sites in south India are carefully recorded and classified according to a typology. This having been done, links can then be seen between different sites where similar designs are found. The link may be membership of the same cultural group or trade between groups or perhaps similarity in date (McIntosh, 1999). In order for such typological analysis to operate successfully, a tried and tested system of classification needs to be in place and individual items accurately described and recorded. This is equally true when making a case for classroom artefacts as evidence of learning. Here the artefacts to be considered are all

objects of communication – semiotic artefacts. The typologies, although not as immediately apparent as those seen in the varying patterns etched on beads, still need to be identifiable. What is proposed here is the classification of variations in communicative function, in particular of meaning configuration, as a tool for typological analysis of artefact texts (chapter five). In this case, as in archaeology, the importance of being able to spot similarities and differences linking disparate objects is fundamental to subsequent postulations.

The location of an artefact – the precise position from which it was extracted – is of great importance to the archaeologist. If the item has to be removed, photographic and written records must be made of its appearance 'in situ'. This is done in acknowledgment that the artefact becomes something different once removed from its context; that the context shapes what it is. In the case at hand the semiotic artefacts are texts: written, spoken, visual or actional instances of represented meaning. Some are present as physical objects some, being auditory or actional realisations are temporal and have been recorded as sounds or images. Whatever their mode of realisation it has been necessary, with all the artefacts under consideration, to extract them – either by physical removal or recording. This having been done a need has arisen, as in archaeology, to maintain some form of account of the artefacts 'in situ'. In the case of semiotic artefacts or instances of representation of meaning, the context is such a significant player in the shaping of meaning that this issue poses an important challenge. Is there indeed any credibility in postulations drawn from semiotic artefacts thus extracted from their contexts? Again, the comparison with archaeology has been a source of some inspiration. The world's museums are full of historical artefacts which, having been extracted from their sites of discovery are nevertheless the basis of widely accepted versions of past realities. Their contexts, given the affordances of new technologies, are increasingly being re-created and described with audio visual displays thus adding value and enriching the status of these artefacts as bearers of evidence. In a similar vein, it is anticipated that comprehensive accounting for and description of the contexts from which these artefact texts have been extracted will serve to reinforce their validity as the basis of proposed interpretations.

There is one final feature of archaeology which has particular resonance for this study. Sometimes, during excavation, an item itself may no longer be present. Its ghost or imprint, however, can be used to mould its re-creation. The fact that the object once existed leaving an imprint on its surrounding environment makes it worth recording or even recreating. A parallel principle has been applied to this study where not all the artefact texts recorded were fully realised; some are 'ghosts' having been formulated in the minds of students, described and discussed then discarded. It is proposed that these ghost texts are as valid as casts created by the archaeologist's moulds. They appear, in the study, as fragments of student or teacher dialogue or as rough notes or sketches. Although not fully materially realised, they are indicative of particular configurations of meaning – rejected, perhaps, in favour of others. Their existence is nevertheless acknowledged, especially as a layering approach to uncovering evidence has been employed, learning being, as has been noted, an evolving process.

Chapter Two
Theoretical Principles

2.1 Introduction

The following chapter will, through referencing and discussion of the literature in the field, outline the principles on which this research is based. It will account for and acknowledge the underlying theories on which the classification, organisation and analysis of data are based. These principles, as will be shown, are rooted in three interconnected fields: multimodality, social semiotics and theories of learning concerned with representational activity. In relation to the first of these, it is the *focus* of the research that is multimodal for its concern is with meaning wherever it finds expression – in the embodied modes, for example, of movement and gesture as well as in speech, writing and images. Secondly, in foregrounding the contexts and relationships of these meaning making phenomena the research is an *application* of social semiotic theory. Lastly, in equating learning with the activity of representing meaning, these principles position the study at the heart of ongoing problematizing of learning itself: close to Vygotskian theory and emergent explorations of learning in relation to multimodal representation. Embedded in each of these theoretical principles are, as will be shown, identifiable positions and stances which have directed the research. For example, the underpinning principle of social semiotics (that representational forms evolve through their use in social settings) has compelled the analysis to address, as data, instances of meaning making in multiple modes. Likewise the assumption in relevant theories of learning that knowledge making and representational activity are interconnected has directed the research to focus, again, on data which constitute instances of meaning making i.e. multimodal texts. Importantly, although the theoretical frame consists of three different elements – multimodality, social semiotics and theories of learning, it is the co-existence of these within a single conceptual framework that has determined the field of analysis: multimodal educational texts.

In this chapter the key overarching theories will first be outlined; multimodality, social semiotics and relevant theories of learning. Their origins will be accounted for and a critical overview of relevant literature provided. The chapter will end with a

brief review of other related educational research – in particular studies concerning the two curriculum areas at issue: science and history.

2.2. Multimodality

Multimodality is gaining currency in a wide variety of contexts. Although the term here concerns human to human communication (and as such is most readily associated with linguistics), it is useful to note its prevalence in other domains such as computer science, medical imaging, therapy and mobile telephone communication systems. All these instances of multimodality (including the one here) have two important features in common: the complimentary functioning of multiple modes and a proximity to developments in communication technologies. Hence, for computer scientists, multimodality is the harmonious combination of different methods of communication between man and machine - where voice, writing, gesture, text and sound can be used. For a wider range of scientists, however, multimodality concerns the generation of data from a range of sources (known as modalities). This has found application as diverse as on screen imaging of oil pipelines and of the human body (the patented HERMES MultiModality Image Fusion being an example of the latter). Others, in the world of telecommunications cast multimodality as a participatory activity:

> "... a new concept that allows telephony subscribers to move seamlessly between different modes of interaction, from visual to voice to touch, according to changes in context or user preference". (Woods, 2002)

Multimodality, moreover, is a concept that has only recently found articulation. Usage of the term is in a state of flux, yet to be established in its fields of application and specificity of its focus. Consequently it is particularly open to misconception and is heavily reliant on contextual usage for understanding. Its patenting (albeit with the distinguishing capitalisation) is not an insignificant occurrence. In the face of such potential ambiguity it is important to use the term confidently and with precision while maintaining an appreciation of its very real and meaningful links with alternative usages. While multimodality as an underlying theoretical principle of this research will be explored below, what is generic to multimodality in its very widest sense can still usefully be noted. Firstly wherever the term multimodality is found there is an awareness of modes as stimuli of the *sensory* elements of human

experience: sound / hearing, visuals / sight, physicality / touch and so on. Secondly there is also a common acknowledgement of the potentials afforded by the *co-*occurrence of modes. Lastly, as has been noted, there are persistent relations between multimodality, in all its usages, and the digital technologies. On offer are a bewildering range of digitally mediated forms of communication which, to some degree or other, simulate the experience of face to face human interaction: they can occur in 'real time', juxtapose visuals and sound, display moving images and so on. In so doing, that which was taken for granted in human interaction has found conscious articulation and generated new forms – 'smileys' in Email simulate facial expressions, chat rooms re-create opportunities for chance encounters, animated gifs and audio links on web pages provide the movements and sounds co-occurent with face to face interaction and so on. In seeking to simulate it, technology, it appears, has prompted the most fundamental reappraisal of human interaction. The greater our involvement with technology has become, the more pressing the need to characterise the multimodal nature of *human* sensory perception.

How multimodality should be regarded (as a theoretical principle or a field of application) is, at the outset, worthy of consideration. Certainly it is conceptually linked, though not synonymous with, semiotic theory which precedes it by some decades. Jewitt and Kress (2003) state that:

'Multimodality is the field in which we apply semiotic theory'. (p.9)

Although useful in its clarity, this distinction belies a theoretical positioning already inherent in the declaration that multimodality is a *field* of study. It is worth, as has been said, identifying with some precision what an adherence to the existence of such a field implies. In so doing, a grappling with the interrelationship between *field* and *theory* (in this case semiotic theory) will necessarily be entered into. This raises questions regarding the factors which led to the emergence of multimodality as an issue of theoretical concern in its own right. Answers must surely lie, at least for the occurrence of its usage in the proximity of linguistics, in the changing patterns of human communication over recent decades as propelled by advancements in digital technology; the increased speed of telecommunications, the increased capacity to transmit images and the shift from page to screen based communication to name but a few.

As has been noted, social semiotic theory emerged prior to multimodality bringing with it a focus on the meaning bearing potential of all human activity. In approaching signs as the unions of signifiers and signifieds, early semiology concerned itself with the abstract formulation of meaning as expressed in its material realisation (Saussure, 1974). In so doing, it opened up possibilities for considering a wide range of realisations. Images and objects could also be signifiers. Barthes (1973), for example, focused on meaning rather than form and was thus able to apply Saussure's general science of signs to non-linguistic phenomena offering new perspectives on cultural activity such as advertising. While not explicitly concerned with multimodality, his work certainly instigated consideration of the meaning bearing potential of a wide range of non-linguistic phenomena. To Barthes, however, language was the ultimate signifier in relation to which all others operated; it was indispensable. Shifts in communication practices, however (most notably the increasing reliance on images) are forcing a reassessment of this position.

Meanwhile the emerging discipline of *social* semiotics (Halliday, 1978; Hodge and Kress, 1988; Kress, 1993; van Leeuwen, 2005) has proposed that the meaning bearing potential of *all* signifying modes (including language) is determined by the conventions and practices of social context. From this position, the focus shifts to the potentialities of modes and their constraints and affordances as signifiers – the hierarchical organisation of modes becomes anomalous. Language, thus, is a mode, like any other, with particular signifying potentials and limitations. It is in the context of this flatter, all encompassing view of meaning making, brought about by the contextualising and positioning of social semiotics, that the term *multimodality* will be used here. It is

> '... the common operation of semiotic principles in and across different modes' (Kress and Van Leeuwen, 2001, p.2)

and a direct consequence of contemporary semiotic practice. Kress and Van Leeuwen (ibid.) refer particularly to the decrease in hierarchical organisation of text production on the basis of mode and the increasing integration (and consequent multiskilling) brought about by digital technologies. In short the phenomena (texts) described by the early semioticians were organised differently – with greater deference to the signifying power of words than is found today. Multimodality, then, has taken shape

as a concept at the convergence of changing communication patterns and the development of social semiotic theory in which modes are the result of

> '...culture shaping material into resources for representation.'
> (Jewitt and Kress, 2003 p. 14)

There is no doubt that the digital technologies have, in a short space of time, made available a wider variety of communication media than ever before. In developing, from semiotics, the analytical tools for this changing communication landscape (pioneered by Kress and van Leeuwen's (1996) work on visual design) the realisation has been emerging that *all* instances of communication are, and have (at least to some extent) always been multimodal. Every text has a meaning potential that can only be gauged with an appreciation of how it functions multimodally. Armed with this realisation, even the choices of font, the printing and layout styles, the paper and ink quality of texts previously assumed to be monomodal (i.e. written) can be opened up in new ways. Moreover, in acknowledging, the multimodal nature of *all* texts there is tacit adherence to the integrative and complex compositional nature of texts. Modes which are co-occurent in a text no longer operate in isolation but are in some way co-functional. The principle of multimodality thus affords the possibility of a unifying theory that can encompass all modes. It would appear, then, that the differing attention required of texts by the onset of dramatic changes in communication practices has forced a fundamental reassessment of how meanings are made.

As a nascent academic discipline, the scholarship concerned with multimodality is, as a body of work, growing rapidly and in the process of acquiring patterns and consistencies. Where the main strands of theoretical development will run and which works will come to be regarded as seminal has yet to be fully seen. In order to systematically review the literature at this stage, however, it has been necessary to create categories and groupings. This has been done in order to facilitate an orderly account of what has been written to date while acknowledging that work in the field is developing rapidly.

To date the literature on multimodality falls, broadly, into three categories all of which draw heavily on the work of M. A. K. Halliday (1978, 1985). Firstly there is the body of work produced in Australia and later in the UK derived from social semiotic theories of communication (Halliday, 1978; Hodge and Kress, 1988; Kress,

1997; Kress and van Leeuwen, 1996; van Leeuwen, 1999; Kress and van Leeuwen, 2001; and van Leeuwen, 2005). Developing at a comparable rate, also with origins in Australia, is a parallel body of work featuring direct application of the principles of systemic functional linguistics (SFL) to multimodal texts (Halliday, 1985; O'Toole, 1994; O'Halloran, 2004; Ventola et al, 2004; Baldry and Thibault, 2005). Lastly, grouped separately both because of its direct application to this research and its significance in its own right, is the literature based on research carried out in the UK which addresses multimodality in education (Kress et al, 2001; Jewitt and Kress (eds.), 2003; Kress, 2003 (b); Kress et al 2005). What follows here is an overview of the origins of these bodies of work, the areas they have covered and the key issues raised.

2.2.1 Social Semiotic Perspectives

During the 1970s M. A. K. Halliday wrote a series of essays published together under the title *Language as Social Semiotic* in which he explored language in use as an expression of shared systems of value and knowledge (i.e. the social). This work, influenced by anthropological studies, was at odds with conventional linguistics in two important ways: it concerned itself with situated language rather than isolated sentences as units of study and its conception of grammar was as a set of choices rather than of rules. Applying the same principles to the constitution of meaning more generally Hodge and Kress sought to describe the

> '... complex interrelations of semiotic systems in social practice; all of the factors which provide their motivation, their origins and destinations, their forms and substance'. (Hodge and Kress 1988, p. 1)

Above all they identified the existence of genres as typical forms of texts linked to particular social situations and sought to theorise the conditions surrounding production of texts. They concluded that meaning is always negotiated and identified texts themselves as sites of struggle. Implicit in this work was the acknowledgement that any such social theorising of the constitution of meaning needed to concern itself with all semiotic systems, not just the verbal. This opening up of other modes was an outcome not only of the social theorising of meaning making but also of the interest in meaning making in general. Hodge and Kress (1988) and later Kress and van Leeuwen (1996) and Kress (1997) emphasised the importance of the material nature

of signs and the meaning of form. It was proposed that the constitution of meaning involved the shaping of available resources for the situation at hand. This being the case, the material forms of all modes were as open – with their varying affordances and observable regularities of arrangements - to theorising as, say, the syntactic structures of verbal utterances. Indeed there was deemed to be an overshadowing of thinking concerning children's literacy development by the reductive emphasis on one mode of representation: the verbal (Kress, 1997).

By 1996 Kress and van Leeuwen had, inspired by their developing concern with the overarching principles of meaning making derived from Halliday, devised what they termed a 'grammar of visual design'. By understanding meaning making as the conjunction of analogy, materiality of form and social positioning they were able to open up for analysis the structural choices inherent in all forms of visual communication. Their adherence to the three metafunctions of Halliday's systemic functional linguistics: the ideational, the interpersonal and the textual was to prove attractive to scholars and a potent enabler of a wide range of multimodal analysis. Their frameworks have found favour with both established and new researchers working on multimodal texts ranging from film (de Grauwe, 2000) to CD-ROM programmes (Zammit and Callow, 1998) to human rights related texts (Martin, 2002) to childrens' television (Palframan, 1999). Kress and van Leeuwen's 'Reading Images' (1996) was the first comprehensive application of semiotic theorising to a non-linguistic mode and is a work that continues to grow in influence. In spite of its focus on a single mode – the visual, it remains the most influential work on multimodality to date.

The emerging principles of multimodality were, arguably, best expressed some years later by Kress (2003 p. 25 - 60) in a chapter entitled 'Literacy and Multimodality'. The growing realisation that meaning making in general needs to be addressed is rooted in his account of the process as one of *analogy* in which the sign maker's interest (i.e. what is regarded as most salient about the object to be represented at the given moment in time) leads to the fashioning of a specific mode into a representational resource. Thus a theory of meaning becomes, by necessity, a theory of multimodality. Working from the same principle van Leeuwen's work 'Speech,

Music, Sound' (1999) explores the use of sounds as semiotic resources - 'this book' he writes in the introduction 'is about semiotics'.

The first full volume to bear a multimodal title was published in 2001 - a collaboration, not surprisingly, between Kress and van Leeuwen. Returning to the focus on discourse (as in Halliday's (1978) socially constructed knowledges) this volume, 'Multimodal Discourse', examines, with the privilege of an overarching multimodal theory of communication, the discourse, design and distribution of communication in a diversity of modes: language, image, music, sound, texture and gesture. Having moved away from the focus on a single mode the writers here raise fundamentally challenging questions about what does or may constitute a mode. They conclude that there are no fixed criteria; that what constitutes a mode is fluid – determined by the needs and priorities of specific groups at particular times. They propose that:

> 'Modes are semiotic resources which allow the simultaneous realisation of discourses and types of (inter)action.'
> (Kress and van Leeuwen, 2001, p.21)

The question remains, however, of where to position multimodality as an academic discipline in relation to the array of more established subjects on which it impinges: communication and media studies, visual design, linguistics and cultural studies. The inclusion of multimodality as a subsection in a publisher's linguistics catalogue (Equinox, 2005) is just one instance of its academic positioning. Multimodality has, and will continue to make equally valid appearances in a wide range of domains.

2.2.2 SFL Perspectives

As has already been noted, multimodality is also well established in the community of linguists identifiable as practitioners of Systemic Functional Linguistics (SFL). Although there are a number of parallels with the literature referred to above, there are also some significant differences; here it is the application of SFL as an analytical tool that has been the primary inspiration. It is Halliday's work on functional grammar (1985) that has been the dominant influence rather than his work on social semiotics. Consequently the focus of the works referred to below is less on overarching theories of meaning-making than on extending multimodal applications of SFL. Of this literature the most influential to date has been that of O'Toole (1994)

on displayed art, sculpture and architecture. This work, frequently cited by those working on multimodal application of SFL in Australia, Singapore and, more recently, the United States, explicitly concerns itself with *art* rather than images in general. As such it can be said to participate in the social and cultural classification of images. As has been noted by one critic,

> 'belying his anti-elitist pronouncements, virtually all of his target works are works of a high pedigree' (Keefer, 1996)

The success of O'Toole's work, however, lies in its demonstration of the application of a range of taxonomies; of functions and subfunctions to facilitate the semiotic analysis of painting, sculpture and architecture. He does, however, evade the arguably more ambitious work of proposing a single overarching set of functional categories for the three art forms he addresses producing instead a bewildering complexity of taxonomies and attendant terminology. In spite of this, O'Toole's analytical frameworks have proved inspirational in two important respects. In contrast to the art historians' preoccupation with what is external to the work of art, his functional approach, where most successfully applied, yields rich findings through sustained analysis of the work itself. He also opens up the possibilities for further application of systemic functional analysis, for example to architecture, and has inspired many.

In a similar vein O'Halloran (2004 a) and Baldry and Thibault (2005) have used the frameworks of SFL to meet the challenges of multimodal text analysis in the handling of corpora of multimodal data. Utilising the latest digital technology, Baldry (University of Pavia) and Thibault, (University of Venice), have developed the Multimodal Corpus Authoring system (MCA), a web-based multimodal concordancer. This tool, a multimodal response to the application of corpus linguistics to dynamic texts such as film, facilitates the transcription of co-occuring multimodal data – images, sounds, speech, gesture etc. Reapplying the corpus linguists' attention to patterns and rates of occurrence of particular features, the MCA facilitates transcription of co-occuring images, sounds and other communication modes in such a way that patterns and regularities can, with the tutored use of appropriate software, be observed. Although the MCA has so far been modelled only on commercially produced film texts such as car advertisements (Baldry and Thibault, 2005), it is the anticipation of the originators of MCA that the system could also be

used for the transcription of a wider range of texts (Baldry, Thibault, O'Halloran, 2005) including, those produced in educational contexts.

A further application of digital technology for transcription of multimodal data is demonstrated by Norris (2004). Although this work does not align itself explicitly with SFL it is referred to here because of its methodological proximity. For example in Norris's work, as in that of Baldry and Thibault, a primary focus is the development of a transferable, teachable, methodology. With Norris, however, it is the multimodal features of *interpersonal* interactions that come under scrutiny - a phone conversation, a guitar lesson, a meeting and so on. The use of recorded data (sound and images) from these interactions offers a practical demonstration of multimodal analysis. In addition to this, the fact that the transcriptions are of *simultaneous* interactions (proxemics, posture and speech) makes it possible, it is argued, to theorise the co-occurence of these modes of interaction. Differing levels of participants' attention / awareness are interpreted in terms of a foreground – background continuum of modal density. As such this work offers useful tools for multimodal analysis. What it is not, however, is an application driven response to a unique research problem. As with the MCA, there is extensive muscle-flexing of the methodology; the potential of which is amply demonstrated but, arguably, has yet to be put to the service of sustained, theory-led investigation. Although most impressive in their technical achievements, the methodological work of both Norris (ibid) and Baldry and Thibault (ibid), also raises a number of key questions which are emerging with increasing force in all areas of multimodal analysis - What constitutes a mode? How, for the purposes of analysis, can the ethereal and temporal modes be transcribed alongside those with which they are co-occurent? And how can the collaboration of modes in the representation of meaning be accounted for?

2.2.3 Educational Perspectives

A multimodal approach to educational research opens up for analysis the non-verbal communication practices which have always played a significant role in the classroom but have rarely been accounted for. Few educational researchers, however, have so far identified multimodal analysis as capable of offering fresh insights. Where it has been utilised, however, the abundance of multimodal data in all interactions around teaching and learning is proving to be a rich seam and one which will no doubt

continue to be exploited by researchers from an increasingly wide range of backgrounds. O'Halloran (2004 b), for example, has developed an approach to mathematics as a multisemiotic phenomenon tracing the multimodal presentation of mathematical problems since the Renaissance. Jewitt (2003) has applied multimodal analysis extensively to the arena of computer mediated learning and most recently, the creators of the MCA (see above) are addressing its usefulness in educational contexts (Baldry, Thibault, O'Halloran, 2005). There is every indication that both the range of small scale projects and the amount of externally funded research is set to expand.

Of those who have already begun to address the multimodal practices involved in teaching and learning, the most extensive work has come from those identified here as practitioners of social semiotics. In the UK two research projects focussing on multimodality in educational contexts have dominated the field: the first led to the publication in 2001 of 'Multimodal Teaching and Learning: the rhetorics of the science classroom' (Kress et al) and the second to 'English in Urban Classrooms: a multimodal perspective on teaching and learning' (Kress et al) in 2005. In addition to these, a collection of work addressing multimodality in a wide range of educational contexts appeared in the volume, 'Multimodal Literacy' edited by Jewitt and Kress in 2003. Of these it is 'The Rhetorics of the Science Classroom' which raises the most fundamental issues around multimodal representation and teaching and learning and has been the single most influential work for this research. Drawing data from secondary school science lessons – both teacher led input and students' own responses in the form of verbal (written), visual and three dimensional representations (models) it not only makes significant methodological inroads into the difficult area of multimodal transcription but also models an effective approach to analysis. Methodologically, as has been noted, this work is driven by the need to uncover what is happening in terms of teaching and learning. To this end it uses a range of different transcripts and categories for organising the data. There are transcripts which include written descriptions, sketches, transcribed speech and combinations of these, time-based tables of co-occurent representations in different modes, function-based tables of Interpersonal, Ideational and Textual elements of representations in different modes and various other tables such as the one entitled 'Students' textual representation of elements in their models of a cell'. This eclectic methodological approach is extremely useful in demonstrating the suitability of multimodal data to a

range of classificatory and interpretative systems – all of which prove capable of yielding important insights. The use, furthermore, of rhetorics as an organisational tool for this data is groundbreaking offering a genuinely theory led approach to the methodological challenges of multimodal analysis. In this case the rhetorical frames that are identified serve particular epistemological functions ('Ontology of the everyday', 'See in a new way', 'Constructing knowledge as a given fact' etc) and as such are designed to help get at the elusive business of teaching and learning. What the study also demonstrates with resounding exactitude is the communicative power (greater than the sum of its modal parts) of multimodally orchestrated meaning. For example, a teacher's multimodal explanation of the movement of blood around the human body is shown to effectively utilise the modes of speech, action and various visual representations combining at differing levels of abstraction and analogy to create a representation of an invisible physical phenomenon. Nor is this example presented as unique but as typical of the regularly occurring communication practices of the science classroom.

The approaches of 'Multimodal Teaching and Learning' (ibid), it should be noted, are entirely in keeping with the theoretical stance chosen for this research. Both are rooted in social semiotics and are, as such, concerned with the creative work in producing signs. In terms of the framing of this research, 'Multimodal Teaching and Learning' offers an interpretation of learning as a process of transformation. In demonstrating the semiotic complexity of both the educational input of the science lessons and the students' work produced as outcomes, it is drawn, in its closing chapters, to making ever more explicit statements concerning the invisible process, evidenced in the students' representations, which occurs as a result of the various educational inputs. The final chapter is entitled 'Materiality as an Expression of Learning' and has this to say about the students' models of cells:

> 'The models are an expression of *learning as a transformative process* which required the students to engage with thinking and learning in a way that a purely linguistic task would not have required.' (Kress et al, 2001, p. 170)

The implications of this unequivocal affirmation of multimodality in relation to learning have, for this research, been far reaching. This research also recognizes the

importance of innovation and creativity in the development of multimodal methodology – a stance which has proved uniquely influential in its design.

'English in Urban Classrooms' offers a multimodal perspective on a conventionally linguistically dominated area of the curriculum. Taking on what could be perceived as a monomodal domain of the curriculum, the study offers wide ranging multimodal perspectives – from the physical classroom as a sign in its own right to the temporal rhythms of English lessons and the potentialities of visual and embodied representations present or enacted in the classroom. In so doing, it exposes the semiotics of schooling as realised in an array of multimodal features present in even the most language-focussed of lessons. This opening up of the meaning inherent in the temporal and physical organisation which surrounds (and can not be separated from) the taught curriculum has provided important insights for this research. No aspect of school life, it has shown, can not usefully be subjected to multimodal analysis.

In addition to the two principal works in the field of multimodality and education referred to above, there have been a number of smaller scale research projects several of which are documented in 'Multimodal Literacy' (Jewitt and Kress (eds.), 2003). Here the research spans education from the very earliest years - a two year old's physical and bodily involvement in constructing time as 'beginning and ending' (Lancaster, 2003) to secondary school students' models of characters in a studied literature text (Stein, 2003). In spite of their wide ranging focus, the chapters are effectively drawn together by the common threads of multimodality and learning. In their very diversity they demonstrate the wide range of the appeal of multimodality to educators from all backgrounds. A number of the chapters deal with computer mediated learning where the multimodal approach facilitates theorising around the learners' engagement with the multi-sensorial experience offered by screen texts. Both Jewitt (2003) and Burn and Parker (2003) conclude that the relationship between multimodality, learning and the new technologies is one that needs to be better understood and made more explicit for teaching and learning to benefit from the screen based technology. That the efficacy of multimodal analysis in extending learning potentials has been so effectively demonstrated in such diverse educational settings is significant. Wherever educators are grappling with issues at the heart of

teaching and learning, multimodal perspectives invariably offer a rich source of inspiration.

2.3 Social Semiotics

As has already been shown, the ideas and concepts around social semiotics have been fundamental to the inception and application of this research. Social semiotics has already been touched upon as a perspective from which multimodality has been approached and as a principle from which, it has been argued, the principles of multimodality themselves have emerged. It will be helpful, however, to accord the field some description in its own right, not only with regard to the literature of semiotics and its offspring social semiotics, but also to exemplify the application of social semiotic theory.

The ideas about language which have come to be known as semiology or semiotics were proposed by Ferdinand de Saussure in his Course in General Linguistics published posthumously in 1916 at the instigation of his students. His explorations of language *as a system* found favour with Trubetzkoy (1890 - 1938) and those in the Prague School of Linguistics (1928 – 1939) whose structuralist literary analysis became a major force in linguistic functionalism. These influences grew during the mid twentieth century and became part of the movement which was concerned, in a range of domains, with deconstructing that which is deemed to be common sense or natural. Saussure, Barthes and European structuralists - linguist Roman Jakobson (1973), anthropologist Claude Levi-Strauss (1977), and literary theorists Julia Kristeva (1980), and Umberto Eco (1976) were all pioneers in the intellectual movement that believed semiology was the key to unlocking the meaning of all things. Saussure had, inspiring a range of applications, opened up language for analysis as a self-contained system of inter-related elements in which meaning was derived primarily from differences within the system. Fundamental to this system was the sign itself; the conjunction of signifier and signified. In Saussure's analysis the relationship between these two, however, was taken to be arbitrary – different languages used different words for the same thing, so how could it be otherwise? In spite of this there were, Saussure allowed, instances in which a degree of non-arbitrariness or motivation could be perceived between signifier and sign – for example where onomatopoeia was used to artistic or literary effect. These instances

he termed 'symbols' maintaining, however, that they too – given their differences between cultures - must also be ultimately arbitrary. Such discussions, however, were subsumed into Suassure's overriding proposition: the division of language in to *langue* (the higher level abstract system of internal relations) and *parole* (the realisation of that system in acts of communication). Of these, it was only *langue*, the abstract systematic principles of language which Saussure deemed worthy of the linguist's attention.

There were, however, those who were openly ill at ease with the implicit determinism of Saussure's dichotomy. Prior to Saussure, the work of C. S. Peirce in the United States had alluded to the pressing need for engagement with the sign as a dynamic entity. In spite of casting semiology as consisting of definable relationships between signifier and signified, Peirce also raised fundamental considerations concerning the *practice* of sign making which seem to contradict the more deterministic elements of even his own classificatory system. (His *icon*, *index* and *symbol* were proposed as variant forms of signifier-signified relationships as determined by conventions and culture.) In 'Logic as Semiotic: The Theory of Signs' (1955) written in 1910, he emphasizes and dramatically illustrates what might retrospectively be termed the shaping power of social context on the signifying relationship.

> 'Two men are standing on the seashore looking out to sea. One of them says to the other, 'That vessel there carries no freight at all, but only passengers.' Now, if the other, himself sees no vessel, the first information he derives from the remark has for its Object the part of the sea that he does see, and informs him that a person with sharper eyes than his, or more trained in looking for such things, can see a vessel there; and then, that vessel having been thus introduced to his acquaintance, he is prepared to receive the information about it that it carries passengers exclusively. But the sentence as a whole has, for the person supposed, no other Object than that with which it finds him already acquainted. The Objects – for a Sign may have any number of them – may each be a single known existing thing or thing believed formerly to have existed or expected to exist, or a collection of such things, or a known quality or relation or fact, which single Object may be a collection, or whole of parts, or it may have some other mode of

being, such as some act permitted whose being does not prevent its negation from being equally permitted, or something of a general nature desired, required, or invariably found under certain general circumstances.' Peirce, (1955, p. 101)

Peirce's engagement with the theory of sign making thus boldly grappled with language at the unpredictable level of what would become known as Saussure's *parole*. This was to become an issue of some contention. In Voloshinov's (1986) critique of Saussurian theory, *parole*, which had been dismissed as incomprehensible, was retrieved and language instated as a *social phenomenon*. Jakobson (1973) also gave precedence to a range of essential language characteristics previously relegated to the disorganised realms of *parole*.

'Saussure's definition of *langue* as 'the social part of language, extrinsic with regard to individuals', in opposition to *parole* as a mere individual act, does not consider the existence of a personal code which removes the temporal discontinuity of the single speech events and which confirms the preservation of the individual, the permanence and identity of his ego; nor does he take into account the interpersonal, social, mutually adaptive nature of the 'speech circuit' which implies the participation of at least two individuals.' Jakobson (1973, p. 20)

Another important respondent to the work of the early semiologists was Barthes whose extension of the fundamental principles of semiotics was used to deconstruct the common sense myths of French culture. For Barthes, popular modern culture was a vast system of signs posing as common sense normality; his task was to uncover their mythology by revealing their reliance for meaning on socially determined values and systems. In this respect Barthes was, primarily, a cultural theorist concerned with demystifying the stereotypes of a largely bourgeois culture. His application of semiology, however, was particularly important for the development of social semiotics in two ways; it focussed on systems of sign making *in general* (not purely the linguistic) and, although concerned with principles and systems did pay unprecedented attention to the practices and conventions in the production of signs. In 'The Death of the Author' (Barthes, 1977) an accumulation of cultural codes are shown to constitute the assignation of meaning to a text; codes which are culturally and historically determined and thus external to the author. In social semiotics the importance of culture and history, as brought to the fore by Barthes, is certainly

adhered to. What is at issue, however, is the extent to which their role is a defining one: do they *determine* or *shape* acts of sign making?

In charting the emergence of social semiotics from early forms of semiology it is also important to note the position held by Barthes regarding the status of non-verbal signifiying modes. He was famously unable to unhinge signifiers of the non-verbal variety from language, going as far as to expresses the view in Elements of Semiology (1964) that no signified could exist without linguistic expression:

> "...it appears increasingly more difficult to conceive a system of images and objects whose signifieds can exist independently of language: there is no meaning which is not designated, and the world of signifieds is none other than that of language...working at the outset on non-linguistic substances semiology is required, sooner or later, to find language in its path ...' (Barthes, 1977, p. 10 – 11)

This research is not alone in refuting this stance: non-verbal modes, it is held, can and do signify meaning autonomously of language. It is precisely in this realisation that the challenges lie - both to our understanding of communication systems in general and their relationship to learning.

2.3.1 Multimodal Sign-Making

To illustrate what is understood by sign-making in the social semiotic context, two examples from the research data will be explored below. The purpose of this exercise is to demonstrate that the sign-making process is motivated; to show that the signs in question are indeed newly made, non-arbitrary and determined by their context of production.

The first signifier to be considered is pictured below:

Fig 2.1: Signifier1

Signifier 1 is a group of unevenly shaped balls with a diameter of about one centimetre. Each ball has a rough texture and is solid to touch. The balls' blue colour is uneven with pale patches suggesting that their interior is white. Viewed in this way, detached from the context of production, the signifier in question no longer operates as intended by its makers but as a meta-sign with a new signified derived from the immediate context; the theory chapter of an academic thesis.

Only with reference to its context of production can this object be reinstated as the originally intended signifier, its signifying potential being bound to social and physical circumstances. By looking at those circumstances, the origins of this sign and its suitability for its particular context can be more fully understood.

Firstly we must look to the context of production. The blue balls were, in fact, made by students in a science lesson. This information gives a number of indications as to how the sign came to appear as it does. It identifies, for example, the sign-makers as young people, and as recipients of education in a school setting. This being the case, the sign-makers' experience of science; of the school science curriculum with its particular conventions, hierarchies and practices, can be said to have shaped their sign-making. As young people, the sign-makers are also participants in particular cultural practices (as distinct from those of say adults or younger children). These conventions too will have shaped their sign making activity.

In addition to the personal elements of the context, knowledge of where production took place also provides information about the origin of the sign; about availability of materials and possible production processes – in this case those of a secondary school science lesson. The materials to hand in this situation were those made available by the teacher (ordered from educational suppliers) and those brought in to school by students themselves. This being the context, production processes were tailored to the time constraints of syllabus coverage and timetabling of lessons. All these factors, and probably more, determined the conditions in which the signifier was produced and its resultant appearance.

The blue balls are, in fact, known to be signifiers for the signified *particles* appearing, as they do, because of a one-off set of circumstances. Their size was determined by the requirement to be visible in a whole class presentation, their colour by the paint available in the science department and by scientific conventions of colour coding. Their material (cotton wool) was determined by availability and the psychological references of the sign makers, their texture by the classroom conditions, time constraints and so on. Lastly it must be acknowledged that the signifiers appear as they do because of the part they were required to play in the students' presentation concerning filtration of a solution. Their size, shape and colour all had to be considered in relation to this specific function. In short the blue balls are only signs for particles because of a unique set of conditions; there is no fixed relationship.

The second signifier to be considered is pictured below:

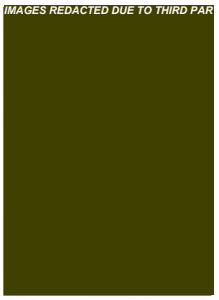

Fig 2.2: Signifier 2

What is shown is a photographed section of a visual representation. Although part of a larger signifier, what is shown is also a signifier in its own right. It was created – the outline and dashed line drawn in grey marker pen, the shading done in grey crayon - with the intention of creating a sign. In this case the possibility of the re-contextualised signifier operating as its makers' intended sign is greater than in the previous case. Unlike the blue balls which in the immediate context offer a puzzling array of possible interpretations, what is shown above is likely to be understood to signify a (section of) road. This fact, however, only serves to reinforce the principle of the motivated sign for it is by identifying commonalities between contexts of production – the history lesson presentation and this page - that the comparable operation of the sign in the two contexts can be accounted for. The original context again involves students as the sign makers and other class members and the teacher as recipients. In this case, however, certain shared characteristics between the cultural

experiences of the students and those of likely readers of this study have important features in common. The context in common is recipient awareness of roads in urban areas in the UK; their appearance and function. In this case the context is broad and creates a very wide community of recipients with shared experience. It is not, however, universal. Not all roads have road markings – those without markings being more typical in the experience of rural dwellers than of urbanites. Nor are all roads constructed with a uniform coloured material. In the past cobbles or larger slabs may have been more typical. Non-paved roads, in addition, correspond in colour to that of the soil. Prior to motorised transport the ruts of cart wheels may have been more familiar road markings and even today the dashed lines are only in use on major roads. In spite of these historical and current cultural differences, readers of this thesis are likely to interpret a grey strip with dashed lines down the centre as a *road.* The sign, however, is not arbitrary.

In demonstrating the motivated, non-arbitrary nature of signs, attention is necessarily directed towards the motivating factors themselves – what, then, *does* lead to the production of particular signs? Central to this question is an understanding of the processes involved in the activity of representation; the conception of analogous relationships (that something can be used to stand for something else), the selection of materials (what is available and suitable) and the realisation of the design (the work involved in making the representation visible, audible or tangible) all of which, arguably, involve learning.

2.4 Theories of Learning

Although learning is central to its thesis, positioning this research in relation to theories of learning has been a complex and challenging undertaking. From the outset assumptions about what constitutes learning and how and when it occurs have, necessarily, been made. In seeking evidence of learning, however, it has also been important to maintain a level of openness regarding the usefulness of different theories. It is against this backdrop of competing concepts, perspectives and stances that the research has struggled to hold in play as many theoretical positions as usefully possible. What follows, then, is a theoretical positioning of the research. A more detailed discussion of the literature which has contributed most significantly to the

shaping of the research – that of Vygotsky (1978, 1962) and Lave and Wenger (1991) will then be undertaken.

This research originated in an appreciation of students' creative, representational activity and its underlying philosophical view of learning is rooted in the acknowledgment of inherent human creative capabilities. Arguably there are echoes here of romantic naturalism (Rousseau, 2000); where learning is promoted through unhindered growth with pedagogy (if present at all) relegated to the creation of conducive environments. Although seemingly far removed from this research with its claim to addressing changing communication practices in the 21st century, the thoughts of educationalists from previous centuries can fruitfully be explored a little further. Derived from Rousseau's naturalistic philosophy, although with explicitly Christian objectives, two German philosophers; Pestalozzi (1746-1827) and Froebel (1782-1852) went as far as to develop programmes of education for the very young. Both were based on socially responsible play-oriented learning which, in their focus on creativity, have a definite bearing on the relationship between representational activity and learning at issue here. Pestalozzi (1894), in particular, was inspired by the belief that all humans, being made in the image of a creator god, are inherently creative and that the acquisition of skills and knowledge is best arrived at through creative engagement in enjoyable tasks. He placed great importance on engaging children's 'sense-impressions', allowing them freedom of expression and developing their language in ways which, in spite of the parallel programmes of rote learning, were revolutionary. Froebel (2000), the founder of infant education and originator of the Kindergarten, believed in the promotion of 'inner connections' between feeling, perception, phantasy (sic), thought and volition. He devised, in the eighteenth century, a series of developmentally progressive toys known as *gifts* and tasks known as *occupations* which are still being produced and marketed today. With their attention to the different senses and their promotion of creative activity and self expression in a range of forms (painting and three dimensional construction as well as speaking and, later, writing) learning, as theorised by Froebel and Pestalozzi, was closely associated with multimodal representational activity. Amidst the plethora of theories that have accumulated in modern times, such simplicity is attractive. What is also apparent, however, is that central issues are recurrent and have largely been recast and realigned rather than radically altered. What are the inherent qualities that

children bring to education? What, then, is the role of pedagogy? And what are the desirable outcomes of education?

Theories of learning are often presented, for convenience, in groups beyond the peripheries of which a small number of theories either bridge boundaries or remain outside them. A common grouping is the *behaviourist*, *humanistic*, *cognitive* trio of theories. Of these the *operant conditioning* of behaviourism is most reluctantly engaged with by theorists today – the animalistic, instinctive elements of human activity being uncomfortably prominent. In spite of this, the shaping concepts of behaviourism - as characterised by the work of Skinner (1968) - are strikingly evident in, for example, the English National Curriculum in 2005. Here learning is to be seen in the measurable outcomes achieved through regulated responses to incremental programmes of study; the ubiquitous learning targets being strikingly reminiscent of Skinner's 'specification of terminal behaviour'. That learners are essentially passive respondents to external stimuli and susceptible to conditioning, is the behaviourist principle most likely to provoke controversy but which, it can be argued, underpins much of the current English education system. Arguably more attractive to practitioners are the cognitive theories of learning focusing on psychological development through education. Here debates around Piaget's developmental stages and Vygotsky's zones of proximal development are engaged in with intensity. Cognitive gestalt theories, meanwhile, have developed the concept that individuals have different needs and concerns at different times, and that they have subjective interpretations in different contexts. There are then those theories that apply neuroscience to learning with interesting findings on the importance of sensory stimulation and the different modes of thinking in the right brain and the left brain. Somewhere between, or encompassing both the cognitive and the behaviourist theories is that of constructivism based on the premise that learning can be equated with the business of extracting meaning from experiences and establishing links and generating mental models with which to make sense of the world. Humanist theories, meanwhile, can be characterised by their desire to empower and activate human potential for fulfilment and general good - the facilitation theory of Rogers (1993) being the most widely recognised of these. There are also holistic theories which seek to engage the learner emotionally and spiritually as well as intellectually (among them the descendents of Pestalozzi and Froebel). Finally, there are important theories

which address the social aspects of learning. Of these, observational learning and social cognitive theory play an important role although none has had an impact on this study comparable with the works of Lave and Wenger (1991) and Wenger (1999) concerning their theory of situated learning. Here, in the concept of a *community of practice* they provide a coherent rationale for organising many of the other disparate elements of learning theories. It is the community of practice, for example, that determines whether learning tasks are real or artificial, and it is the community of practice that determines the path of learning which may be incremental or constructivist but which is ultimately a career (apprenticeship) from the peripheries of the community to its centre.

The position of this research in relation to the complex web of theorising around learning is one of both privilege and vulnerability. Although explicitly focussed on the task of uncovering evidence of learning this research is neither allied to nor developed from a particular theory. This position affords the privilege of addressing learning in all its diverse forms (e.g. cognition, sensory involvement, social interaction) without setting theories in opposition to one another. Without a single coherent theory of learning however, comes an element of vulnerability. This having been said, the merits of the research with regard to the theorising of learning will be determined by the success with which this balance between vulnerability and privilege can be managed.

Before exploring the work of two particularly relevant theories of learning, the position of this research *as an application of social semiotics* with regard to learning will be explored in more detail.

> 'Learning and sign-making are two sides of one sheet of paper...dynamic processes which change the resources through which the processes take place – whether as *concepts* in psychology or as *signs* in semiotics – and change those who are involved in the process.' (Kress, 2003, p. 40)

In its semiotic interpretation of the representation of meaning it is useful to draw parallels between the three elements of the sign making process (the signifier, the signified and the sign) and potential counterparts in theories of learning. In semiotics the signified is the represented object which, in terms of learning, can be said to be the

abstract or real entity which will constitute an element of knowledge to be learnt. The sign, in terms of both learning and semiotics more broadly, is the individuals' unique conceptualisation of the object on the basis of which the signifier is produced. The signifier itself, then, is the material expression of both the sign and the learning that has taken place. Theories of learning, however, have tended to concern themselves either with the objects of learning (the signifieds such as curriculum content) or with the outcomes (the signifiers or products) but have rarely addressed the business of signification itself: the formation of relationships between signifiers and signifieds. Herein, surely, lie discussions about development and construction, the natural human potentials, the role of the brain and neurology as well as susceptibility to behaviourist programming. Relating signified to signifier is also a social activity raising issues of empowerment and belonging. Drawing together at least some of these perspectives is the work of Vygotsky (1962) with its focus on the role of language as both a participant in the conceptualising (of the signifier) and in its articulation as a sign – fundamentally a social act.

The relationship between the two processes: that of sign-making and that of learning will resonate throughout this research. Are the two processes in fact one and the same? Does one lead to the other, or are they somehow mutually interdependent? Although these questions will remain unanswered, their persistence bears witness, like the endurance of the eighteenth century theorists, to the vast potential of human creativity. What can be asserted, however, and is reiterated throughout this research is the proposal that representations are *evidence of* learning; that learning is a pre-requisite for the realisation of a material text and that in identifying the choices behind these representations the learning can be uncovered.

2.4.1 Vygotsky

Vygotsky's work has proved particularly stimulating in theorising this research because of its emphasis on the part played by social interaction in, what he as a psychologist terms 'cognitive development' but which is here referred to more generally as 'learning'. Vygotsky was also profoundly concerned with language – both how it is acquired and its use as an intellectual tool in the internalising of knowledge that exists outside the child. As learning progresses, Vygotksy proposed, the child's own language comes to serve as their primary tool of intellectual

adaptation. Eventually, children can use internal language to direct their own behaviour. As the leading proponent of social cognitive theory Vygotsky has had a direct impact on pedagogic practice. That learning is best achieved through shared problem solving of meaningful tasks is a relatively easy principle to apply in the classroom. More difficult to translate in to pedagogic practice, however, is Vygotsky's idea of the Zone of Proximal Development (ZPD): the area of learning just out of independent reach but obtainable with support and guidance through the scaffolding of tasks. The principle of scaffolding has thus found many practical expressions (from the provision of written prompts for students' writing tasks to the presence of *help* links on web sites). What most forms of educational scaffolding fail to address, however, is the importance of identifying each individuals' unique need for support - the ZPD being specific to each learner.

With the particular stance on multimodal representation taken by this research, it is entirely plausible that Vygotsky's recognition of the power of language in formulating inner meaning (or vice versa) is applicable to non-verbal modes. If indeed language is just one form of semiotic activity (albeit with the double articulation necessitated by verbal language) then there is no reason why visual representations or the embodied modes such as gesture and action should not also be regarded as central to the processes of cognitive development. Moreover, if articulation of meaning in words is indeed as fundamental to learning as Vygotsky would have us believe, the power of other modes of representation in relation to learning becomes very interesting indeed. Do other modes replace language or complement it? Do they afford different opportunities for intellectual development and if so how can they be exploited? Vygotsky identifies particular phases of concept development in relation to language moving from haphazard groupings through to the development of fully fledged concepts based on abstract reasoning arrived at through experience. He also differentiates between so-called everyday and scientific concepts - movement between which relies on successful adaptation to intellectual challenges. In all these descriptions Vygotsky relates cognitive development to language – the use of 'because' for example, to an understanding of cause and effect rather than just consequence. What Vygotsky's work on language and learning presents to those concerned with multimodality and learning is a challenge to match the rigour with which features of verbal language (such as grammatical structures) are related to

different elements of the process of learning. If representation in all modes effectively follows the same principles of semiosis, there should indeed be traceable indicators of learning in the structure of visual, three dimensional and embodied modes. If it can be done with language can it be done, and to what extent, with other modes?

In casting learning as an essentially *social* activity Vygotskian theory again, it will be argued, foregrounds the representation of meaning. If an activity is *social,* it must incur interaction and interaction is none else than a contextualised exchange of representations. It can equally be asserted that *semiotic* activity is what constitutes social interaction – whether through speech, gesture or the broader social constructs of written texts or temporal institutional structures. That learning is social, then, demands a reappraisal of the role of representational activity in all modes. Vygotsky himself proposed that cognitive development results from a *dialectical* process whereby a child learns through problem-solving experiences shared with someone else, usually a parent or teacher but sometimes a sibling or peer. From the standpoint of an interest in multimodal representation it is this dialectical process that is of interest; the interaction engaged in through representational activity whether verbal, embodied or realised in visual form. Vygotsky (1962) himself did carry out some experiments that have a direct bearing on considerations of multimodal representation and the specificities of different modes. He was particularly interested in the sequence in which children became conscious of *action* as opposed to *objects*. Taking children's responses to pictorial representations of action he found that they responded to them at an earlier age than they did to pictorial representations of objects. He did assert however (based almost certainly on verbal evidence) that the children had become 'fully conscious' of the object earlier than the action. In a further study he found that children acted out an action that had been represented but when asked to mediate the sense of the action through speech they failed to do so enumerating, instead, separate objects. Although Vygotsky's, concern was with learning as that which could be expressed verbally, his engagement here with *other* forms of representation and his tacit acknowledgement that they were evidence of *some kind* of learning is significant.

Vygotsky's concern, however, was not with multimodal representation and the connections made here are part of this study's theoretical stance and not inherent to Vygotsky's work. Nevertheless it does, from the reading of Vygotsky given above, seem entirely reasonable to cast this research as a *participant in the development of Vygotskian theory* from the particular perspectives afforded by multimodality.

2.4.2 Lave and Wenger

Lave and Wenger (1991) developed the notion, based on studies of informal adult education, of *communities of practice* derived from theories of social practice, or praxis, as proposed by Bourdieu (1977). They concurred with Bourdieu in the '... inherently socially negotiated character of meaning' (Lave and Wenger, 1991, p.50) and proposed a view of learning as *legitimate peripheral participation.* Their socially oriented theory, unlike that of Vygotsky's, is primarily a way of understanding how learning (unavoidably) happens rather than a proposed strategy or technique. Interestingly, Lave and Wenger's work can be related, in terms of its preoccupations with the social, to Vygotsky's work, at least one interpretation of which (i.e. Activity Theory) casts the ZPD as the distance between individually motivated and societal activity (Wertsch, 1985). In some groups, Lave and Wenger suggest, we are core members, in others we are more at the margins. Adhering to an apprenticeship type model of learning and based on studies of Yucatec midwives, West African tailors, nondrinking alcoholics and others, they describe attempts by those on the fringes to move to the centre as *legitimate peripheral participation.* It is as a consequence of this social necessity to move from the fringes to the heart of the community that learning occurs. In this model, then, learning is an outcome of societal forces rather than a means to a social end. For these and other reasons Lave and Wenger deliberately chose not to focus specifically on what they term 'school learning'. Not only does the school environment complicate the notion of a community of practice with different communities potentially competing at any given time, but its very implementation of learning is based, they would argue, on the fundamentally erroneous notion that it is possible to decontextualise learning. Lave and Wenger do not, however, preclude the application of their theories to school learning stating that;

> 'We wanted to develop a view of learning that would stand on its own, reserving the analysis of schooling and other specific educational forms for the future.' (Lave and Wenger, 1991, p. 40)

The Lave and Wenger model is useful here, however, not only because of its casting of learning as inherently social but also because of its emphasis on the importance of *active* involvement in the community as the means of learning.

> '...the purpose is not to learn *from* talk as a substitute for legitimate peripheral participation; it is to learn *to* talk as a key to legitimate peripheral participation'. (Lave and Wenger, 1991, p.109)

Communities of practice, it is observed, are social constructs and as such generate text types (genres) suited to their particular conventions and purposes. Learning to 'talk' within the community, then, is the key to following the career path from the periphery towards the centre. Given Lave and Wenger's own trepidation regarding the application of their perspectives to school learning it is with some caution that they are applied to the learning situations at issue in this research. Arguably, for example, the students in the history lessons are not just learning *how to be historians* (this is borne out by the teacher's own instructions) but also *how to be students* for they are also participants in the social enterprise of schooling. They are also more or less centrally active in their own communities of practice with regard to their identities as teenagers and girls. Hence they are involved (simultaneously) in at least three different communities of practice each with its own social constructs and discourse. Becoming practitioners in the 'talk' of each of these communities is what their learning entails and is a complex socially organised activity which this research will seek to hold in its perspective.

Participation, according to Lave and Wenger, is fundamental to learning. This involves, this research proposes, the trying out of different representational forms typical of that community of practice.

To summarise, the Lave and Wenger model has proved stimulating for this research in a number of ways: it adds legitimacy to the attention paid to the products of students' participation in their relative communities and provides useful points of reference for understanding the interplay between genre knowledge, multimodal representation and learning. It also ensures that the representational work of the students, however

narrow its analysis, is never unhinged from its social context. Moreover, as apprentices in their various communities of practice, the research subjects are, in Lave and Wenger's terms, viewed in the most revealing of lights - as *emergent practitioners*.

2.5 Curriculum Areas

Although this research aspires to a relevance to representation and learning *in general*, it has, of course, been necessary to locate the research in specific learning contexts. Two sets of lessons, referred to later as *sites of learning*, were used from which to gather data; the school subjects concerned being history and science. While an overview of literature relating to the overarching theories has already been undertaken, it would be inappropriate to proceed without acknowledging key literature that has arisen from work on these specific school subjects. Of the two, research in to the teaching and learning of science is, by far, the most extensive there being numerous dedicated journals, edited collections and full volumes. The teaching of History in schools is, in comparison, strikingly under-researched. What will follow here is a summarised account of the most relevant work to date with some discussion of how key issues raised relate to the concerns and approaches of this particular research project.

2.5.1 Secondary School Science

The teaching of science has, over recent decades, generated significant amounts of research. It is helpful to focus the review here on that which is solely concerned with secondary schools. It should first be noted, however, that there is some research on the teaching and learning of science in primary schools which does focus on issues of representation - for example the work on multimedia of Rollnick et al (1998).

The language of the secondary science classroom has been the focus of several key works: Lemke (1998), Halliday and Martin (1993) and Ogborn et al (1996). Here two issues dominate; the socially constructed practices of speaking and writing in science classrooms and the specific features of scientific writing (e.g. nominalisation as 'grammatical metaphor') in which students are expected to become proficient. The questions raised have thus concerned notions of scientific literacy and its desirability in the public domain, as well as touching on the tension between affective and

cognitive responses to science teaching – is belief or understanding the desired outcome?

Encompassing many of the concerns referred to above, the usefulness of metaphor and analogous relations in the teaching of new science concepts is a frequently recurring focus of empirical studies. Many of these, for example Johnson (1998) and Ogborn and Martin (1996) are based on the linguistic work of Lakoff and Johnson (1982) and several, although not explicitly concerned with multimodality, have considered representation in visual modes. These include an exploration of analogy in teaching about electricity (Stocklmayer and Treagust, 1996) and a study of anthropomorphism in teachers' and students' representations in science (Tabor and Watts, 1996). Closely allied to these works are others concerned with the use of visual and three dimensional modelling in science teaching (Mathewson, 2005, Koll, 2005). Of all these, however, it is the work of Ogborn and Martin (1996) that is the most extensively theorised with its mapping of student and teacher responses to different scientific metaphors on to identifiable 'ontological spaces'. While not intended as exhaustive descriptors of possible dimensions of ideas, they usefully facilitate categorisation of participants' responses and open them up for analysis in challenging ways. These 'ontological spaces' have much in common with the representational configurations at the heart of systemic functional theory as utilised here. There is indeed a thread linking this work through the collaboration on the explanation of science in the classroom (Ogborn et al 1996) - in which the impossibility of separating language from other modes of explanation emerges - to the fully-fledged multimodal work on the science classroom discussed earlier in this chapter (Kress et al, 2001). Consequently it is in relation to this particular body of work on the teaching of science that this research is most closely aligned.

2.5.2 Secondary School History

In contrast to that which exists in relation to the teaching of science, the quantity of research relating to the teaching of history is notably small. Although no attempt is made here to account for this fact, it is acknowledged that this reflects the current contrasting status of the two school subjects in a range of spheres; the core subject status of science in the UK National Curriculum, the social and financial status of

scientists and the subsequent timetable allocations and increased levels of funding for this subject above others in schools.

In the face of the differences noted above, the work of Coffin on students' writing in History stands alone in the field in terms of its scope and academic rigour. In a number of papers arising from research associated with the Literacy in Schools programme (Australia 1992-1994), attention is drawn to the construction of historical knowledge in written texts as evidenced by the application of systemic functional methodology. Through this lens, construction of the past is seen to develop in students' work from an essentially time based sequential understanding to one organised according to abstract ideas and principles (theses). This development is glossed as the move from structuring texts as 'story' to 'argument' – the latter being the end goal of the apprenticeship of 'learning to mean like a historian' (Coffin, 1997). This progression, from the position of being able to create a story-structured text to the point where the student is capable of producing an argument-structured text is developed in detail with overlapping stages identified and mapped out in a clearly charted progression (Veel and Coffin, 1996). Significantly, even here the scientific organisation of the world, it is proposed, dominates and established scientific language functions permeate the structural forms of desirable history texts. Of these, the practices of nominalisation (as a feature of grammatical metaphor), lexical density and the appearance of causal as opposed to temporal markers (see Halliday, 1993) are particularly highlighted (Veel and Coffin, 1996).

In spite of its focus on the single mode of writing, Coffin's work is ultimately concerned with the textual shaping of knowledge and the apprenticeship of learners. As such it is very closely aligned with this research and has directed its analysis in relation to the students' multimodal reconfigurations of their resource texts.

Chapter Three

The Sites

3.1 Introduction

In the first chapter an account was provided of the ways in which a particular series of history lessons aroused an unusually high level of interest. The students' tasks were unconventional (production of multimodal representations in groups), and the levels of student activity intense and richly diverse. This chapter will provide an account of how these history lessons and a second series from science became sites for this research. The second part of the chapter will be an archaeologically inspired survey of the semiotic landscape at each site.

3.2 Identifying the Sites

For the purpose of this account the term 'site' will refer to a series of lessons (a unit of work or study) taught to one class by one teacher in one classroom as part of the regular school timetable. Two history sites, both concerned with the unit on Benin City, were chosen and one where a revision unit on separating mixtures was taught in science. The sites were both located in the same institution: a Local Education Authority girls' secondary school (age eleven to sixteen) catering for a socially and ethnically diverse population in East London. The ethnic mix of the student population was extremely diverse reflecting the well-established White, Asian, Black Caribbean and Black African communities it served as well as the fluctuating population of more recent arrivals from Eastern and Southern Europe, the Middle East, Latin America and other areas. A very high proportion of students spoke English as an additional language. The teaching staff, although predominantly white, comprised an ethnic mix with a significant number of Asian and a small number of black African and Caribbean teachers. In these respects the school shared many common features with other inner city secondary schools at the time of the research. It had a high academic reputation in the borough, was oversubscribed and had the added status of being a 'Beacon' school with a remit to share good practice.

The intention in selecting sites from two curriculum areas was to add depth to the research by providing a comparative perspective - the premise being that the

knowledge cultures of the two different curriculum areas differ in significant ways. In terms of knowledge representation, for example, a tendency is observable in the information–bearing diagrams of science to represent features of the physical world as unchanging truths. Students are not expected to contest or question information but to represent it with accuracy and precision in anticipation of assessment requirements. This is evidenced in the teaching orders for Key Stage 3 Science which preface itemised lists of subject content with the phrase 'Pupils should be taught' (DfES, Key Stage 3 Programme of Study, 2002). The parallel document concerned with the teaching of History, however, emphasises 'knowledge, skills and understanding' which are to be taught *'through'* the study of particular content. Where this content is listed the phrase 'Pupils should be taught about' is used as the preface (DfES, National Curriculum, 2001). In history, pictorial and written sources, are used as evidence and students taught to interpret and identify bias, assessment being based on ability to represent different logically justified views of past events. It was in acknowledgement of these contrasting knowledge cultures and their differing potentials to shape students' representational activity and subsequent learning, that the decision to select sites in both science and history was made.

3.2.1 Locations

Having established the research potential of the history lessons involving representational activity, similar student activities had been sought in science lessons at the same school. The closest match, in terms of representational activity and learning outcomes observed by the researcher had occurred when a year nine class were given the homework task of producing posters about the solar system. As with the Benin City representations in history, the variety of materials and forms used and the richness of meanings embodied were striking as was the extent to which the students were motivated by the task. In the desire for a full set of data from a learning event parallel to the history lessons on Benin City, attempts had been made to identify a suitable unit of work from the year nine science curriculum. After careful discussion and negotiation with the head of science in the school and individual teachers it became apparent that the solar system poster homework was unique and that none of the year nine prescribed units of study required students' involvement in representational activity. Not without some difficulty, and towards the very end of the school year, a solution was found. One of the classes tracked in history was being

taught by a teacher with whom the researcher had previously worked in teaching partnerships. He was interested in the underlying premise of the research and willing to participate in the study. He then identified an optional end of year pre-GCSE revision unit entitled 'Physical Changes' which he could teach to the class in question after they had completed their Key Stage 3 SATs (Standard Attainment Tests). This unit covered the different methods of separating mixtures and the particle behaviour involved. One of the activities in the prescribed lesson plan was 'modelling'. The following instructions for teachers appeared under the heading 'Understanding particles' and the time allocated was twenty minutes.

> 'Ask pupils now to consider for a given example what was happening in terms of particles. Use pupils to model the particle behaviour. Divide pupils into groups and ask each group to model a particular process. Provide pupils with labels to indicate what type of particle they represent, e.g. water, salt or sand. The group mime their process and the other pupils have to agree a commentary that goes with the mime to reflect accurately the various stages in the separating out. This can be in the form of simple sentences that you can support with prompts or it can be structured as a cartoon sequence showing changes in particle behaviour.
>
> Where appropriate discuss the energy transfers made to and from the particles and the effect of this transfer on particle movement.' (DfES, 2002, p.57).

Drawing on the official endorsement of modelling provided by this lesson plan, the teacher devised a three lesson unit of work in which he broadened the interpretation of modelling beyond that offered by the prescribed lesson plan. This was later apparent from his instructions to the students where he listed the following modelling possibilities: a physical three dimensional model, a mime, an action, a play, a picture and a description. He also mentioned that the science department poster trolley - containing an assortment of paper, card, scissors, glue and paint – would be available to them. The unit of work was to consist of the following student activities: completing a prescribed worksheet (wordsearch and gap-fill exercises), watching the teacher perform a series of practical demonstrations, producing models in groups and presenting these to the rest of the class. This sequence of teacher led input, representation of acquired knowledge and presentation was not dissimilar to that of the Benin City unit in history. The teaching focus at this site, however, was narrower, the resources fewer and the time for engagement in representational activity shorter.

Recognising these differences as attributable, at least in part, to the aforementioned differences in knowledge cultures, it was decided that this site would indeed meet the needs of the research design.

3.2.2 Participants

The unit of work in history that had initially aroused interest was an integral part of the departmental scheme of work and as such was covered by every year nine class. This being the case, it was possible to select two classes with two different teachers to focus on for the study. Fortuitously, the class involved at the selected science site was the same as one of those from history. Following the collection of the data from the science site, it was decided to focus in more detail on the single history site at which the same class had been taught. Data from the second history site, it was decided, would serve as informative background material.

The class in question, as has been stated, was of year nine (thirteen to fourteen year old) girls. Typical of all classes in the school, this one comprised of thirty students from a wide range of social, ethnic and religious backgrounds – all but three of them having been born in the UK. Seven different home languages other than English were recorded by the school as being spoken by class members – these were predominantly South Asian languages (Bengali, Gudjerati, Panjabi). In spite of their shared experiences of growing up in East London and attending the same school, it was apparent, then, that the home cultures of these students were extremely diverse. Furthermore, the class had not been 'streamed' or 'set' and constituted a random computer selection from the year group.

A further level of participant selection occurred later during the course of data collection. It was decided to focus in detail on the work of a single group of four students. Consequently it is on their multimodal representational work in both history and science that the main body of this study is focused. The four students concerned were initially grouped together at the history site. As emerged later, the Benin City activity was the first occasion on which these particular students had worked with one another as a group. Eight months later, when the opportunity arose to choose their own groups for the modelling task in science, the same students, following a suggestion from the researcher, decided they would like to work together again.

In spite of the intense focus in this research on the representational work undertaken by just four students, information was not sought on their individual life-experiences, backgrounds or educational achievements. This is entirely in keeping with the objectives of the research in which the principles underlying the relationship between multimodal representational activity and learning were being sought. Perhaps, more controversially, the experiences of the focus group as *female* students have not been given special consideration either – it is not an intention of the study to confine findings on the relationship between multimodal representational activity and learning to one gender. The shaping influence of gender issues on representational activity and learning, does, however, justify a different, specifically designed, study in its own right. How then are the four main student participants to be regarded? Firstly, they are to be viewed, *in respect of their representational activity*, as representative of all students - even in their possession of unique individual and cultural heritages. Secondly, they are to be acknowledged as creative individuals of remarkable value. Given that these qualities are common to all human beings, there is no inconsistency, then, in their being held to stand for all students while being valued in their own right.

Finally the teachers themselves, as active participants at the two sites, are not to be overlooked. Being concerned with the processing of educational input – the transformation of resources into constructed knowledge through multimodal representational activity – the study is interested in the teachers as both suppliers of resources and as resources in their own right. Initially two history teachers were involved as two classes were tracked through the sequence of lessons on Benin City. One of these was the head of department, the other a younger teacher in her second year at the school. Both were female and each taught in her own classroom. The class on which it was decided to focus the research was the one taught by the head of history. At the science site the teacher involved was male, had worked at the school for five years, and had additional pastoral responsibilities. He too taught in his own room – a science laboratory.

3.3 The Semiotic Landscape

In working towards its stated objectives this research will, in terms of the current analogy, excavate the selected sites for evidence of the relationship between

multimodal representational activity and learning. This excavation will entail the identification of key artefact texts and their description, classification and analysis. The following survey of the two sites is intended to provide both a meaningful *context* for these artefact texts and to demonstrate their particular noteworthiness. It will provide wide ranging accounts of semiosis at each site concerning itself with the meanings inherent – the semiotic portent - of the events, human interactions and physical objects present.

In mapping out the semiotic landscape a wide range of multimodal communication will be considered: spatial arrangements, usage and design of physical objects (e.g. buildings, furniture, fittings), temporal rhythms, patterns and regularities of diverse actions and events (organisation of the school day), temporal embodied meanings produced by people at the site (talk and gestures), and lastly physical representation of meaning in written or visual texts (e.g. classroom displays). In identifying these occurrences and features as instances of semiosis the study aligns itself with work on multimodal communication (Kress and van Leeuwen, 2001, Norris, 2004 and Kress et al 2005) and social semiotics (Halliday 1978, Hodge and Kress, 1988 and van Leeuwen, 2005). In these emerging disciplines, as has been discussed (see chapter two), attention is directed to the organising principles underlying the full range of multimodal texts and communication events. Concepts formerly applied to the study of language alone are utilised to identify defining patterns and regularities through which meaning is established multimodally: composition, framing and linking, rhythm and so on. In addition the notion of semiotic *resources* prevails – that meanings are not static but are newly made with each realisation and specific to their unique social and cultural locations. Given its potential for complex and multi-layered theorising, the mapping of semiosis that follows here is relatively superficial and undeveloped. Wider patterns of practice and their theorising are not attended to. For example exploration of the role of mode in shaping meaning is deferred until its development later in the study as a tool for analysis (see 4.7) and its full implementation as such (chapter eight). In spite of this, the initial survey that follows is methodologically well-founded being based on the fundamental principle derived from social semiotics: that physically and temporally occurring phenomena and interactions such as those found in classrooms are not neutral but are shaped by social and cultural factors which do indeed endow them with meaning.

The endeavour will be to provide the equivalent of a fieldwalkers' sketch of the semiotic landscape at the sites - there being an understanding that semiotic landscapes, like geographical ones, are, by nature ceaseless and constantly changing (see 5.1.1). Finally, in line with archaeological field surveying, the intention here will be twofold. Firstly the landscape is to be mapped providing an informative background picture of the *prevailing* and *dominant* patterns of semiosis. Secondly the landmark bumps and hollows: the noteworthy variations in semiosis, will be pinpointed for it is at these points of optimal interest that excavation is to be undertaken. These landmarks indicating the surges and shifts in semiotic activity, it is proposed, are where evidence of learning is most likely to be found.

3.3.1 Prevailing Patterns: Science

Fig 3.1 Semiotic Landscape: science laboratory

Fig 3.1 shows the room in which the science lessons took place; the physical site. Limited though the photograph is, the visible features of the room make it immediately recognisable as a classroom, possibly even as a school science

laboratory. It is important then, to identify which features of the deployment of semiotic resources at this site make it so readily recognisable. The room is a regular shape with no alcoves or lobbies. The ceiling is relatively low and there are two doors: one leading outside (a fire exit) and one leading to an internal corridor. Both doors have square eye-level windows of reinforced glass. The room itself has regular, large rectangular windows on two sides. The light fittings and door furniture are functional, not decorative, the floor is tiled and the seating and tables are uniformly utilitarian. The chairs and tables are stackable. At first the semiotic potential of these objects is not apparent, so commonplace are they in such school environments. They do, nevertheless, signify adherence to particular social and cultural practices. For the purposes of semiotic surveying, the principle is to be maintained that every design and product choice embodies meaning and that attempts should be made to identify at least the most dominant of these. A useful technique for identifying inherent meaning is to mentally substitute contrasting items with those in situ to regain an appreciation of the underlying choices. As van Leeuwen usefully articulates:

> 'Almost everything we do or make can be done or made in different ways and therefore allows, at least in principle, the articulation of different social and cultural meanings.' (van Leeuwen, 2005, p.4)

This being the case, the presence of uniform and functional furniture is an expression of the desirability of conformity and commitment to purpose. Even the light fittings at this site can be subject to the same kind of scrutiny. They are fluorescent strip lights – a form of lighting commonly used where functionality outweighs aesthetic consideration. Their presence here links this site with others where similar lighting may be found suggesting a range of commonalities: the prioritising of work over leisure, the desire for a uniform level of visibility rather than gradation of light and so on. These light fittings differ from those used in, for example, domestic settings where floral inspired shapes, decorative frosted glass, or shiny materials are often common and where the lighting is used to create atmosphere and mood. Other physical features of the room contribute to this contrast with domesticity: the use of tiles (rather than carpet), the rectangular (not circular tables), the regular square shape of the room and the general negation of considerations of aesthetics or comfort. Rather, a strong sense of functionality, conformity and commitment to purpose prevails contributing further to the overall message: this is a site at which purposeful work is to be undertaken by everybody.

For the more direct purposes of teaching science, there are a number of other features at the site which convey additional meaning. At the front of the room (the side to which the chairs face) there is a raised dais on which the teacher's desk is positioned. Mounted on the wall, square to the teacher's desk, is a whiteboard. Encased above the white board is a drop-down projection screen. Extending inwards from the walls a work bench with fitted cupboards underneath runs around the room. Regularly positioned in this workbench are a number of sinks with thin, high arching mixer taps. There are also a number of regularly positioned gas taps protruding form the work top. Mounted higher on the walls around the room are several glass-fronted lockable cabinets containing equipment. These cabinets and a number of cupboards under the work tops, bear large, clearly written, double mounted and laminated labels naming their contents. In fig 3.2 the cabinet containing conical flasks and funnels is shown. The items themselves are ordered and grouped: one shelf for conical flasks and one for funnels. Each set of items are identical in shape and size and are lined up in neat rows which fill the cabinet. The red, white and black colours and shape of the cabinet label are common to other similarly functioning labels around the room. These physical features of the room are directly related to its function as an area for the teaching of science. Of particular note, however, in terms of their role as semiotic resources, are the elevated teaching area positioned at the front, the quantity of science paraphernalia (equipment and facilities), and the regularity, order and identification (labelling) of these items. These have the semiotic function of strongly suggesting a parallel orderliness and accountability where the teaching of science is concerned. The centrality and elevation of the teacher's physical position as well as the arrangement of chairs and tables in rows (with students facing the front) suggest a knowledge distribution model which emanates outwards from a single point: the duplication of central tenets.

Fig 3.2 Semiotic Landscape: laboratory cabinet

Having sketched out the semiotic portent of the most striking physical characteristics of the site, it is necessary to pay some attention to those features that shape the site with similar force but which are invisible to the eye; those features concerned with the allocation and ordering of time. Every event and occurrence inside the physical space of the school building is governed, most pressingly, by the temporal organisation of the school day; the timetable. Progression from each one hour lesson to the next is marked by the automated ring of a bell. The timing of this bell and its sound can not be varied and is equally beyond the control of both students and teachers. At a temporal level above that of individual lessons is the organisation of the timetable over a series of days weeks and terms. These again have their place in an overarching system of time allocation which ultimately represents progression through thirteen years of schooling. From the timing of the hourly bell to the annual movement from one year group to another this temporal text – an integral feature of the site, has considerable semiotic portent. Again uniformity, consistency and progression are heartily evoked. This time, however, the temporal arrangements apply with equal rigour to both teachers and students – deviation being rare and only by special arrangement with higher authorities. Furthermore the temporal organisation of the site necessitates single-tracked, one-way progression - there being no possibility of attending two classes at once or of returning to an earlier lesson, term or year. Adherence to this progression is generally unquestioned, the force behind it being invisible – from the ringer of the bell to the decider of school term dates. Although less readily apparent than other instances of semiosis in this survey, the social and

cultural values invisibly imposed by this ubiquitous, relentless and inflexible segmenting and ordering of time should be acknowledged.

Moving from some of the less conventional instances of semiosis, consideration will follow of the more easily recognisable patterns and regularities of embodied acts of meaning: the gestures, actions and movement of both students and teacher. The teacher's chosen bodily position, not surprisingly, is most commonly in front of the students and facing them. Although the dais was not always used, a distance precluding bodily contact is generally maintained between the teacher and students whether he is speaking from the front or providing a demonstration. He moves around the room freely and is rarely stationery; his positioning at different locations around the room being relatable to different phases of the lesson: typically this consists of initial presentation from the front, demonstration from a work bench, management of student activity around the room and reinforcement at the whiteboard on the dais. In his physical actions the teacher also interacts with and handles a large number of items in the room – the whiteboard, books, equipment, doors etc. Finally he also uses a considerable number of meaning laden hand gestures both in the management of activities (indicating where students should move to, who should speak and so on) and for the presentation and explanation of subject content. Pointing is his most frequent gesture.

In contrast to the teacher's wide range of movements, actions and gestures, the students are largely stationery moving only as and when instructed to do so. They too, however, move according to different phases of the lesson; being seated in rows for the presentation stage, clustered on tables and chairs around the demonstration, sitting again at desks in rows and then standing around the teacher's desk to view the whiteboard reinforcement. Their handling of objects mostly involved their own exercise books, pencil cases and individual worksheets provided by the teacher. They do not handle equipment with the same liberty as the teacher. During teacher led demonstrations they are primarily observers only rarely handling equipment or materials. It was also observed that the students' movements, actions and gestures are largely responsive - moving around the room as directed or putting up hands to answer questions. Not being engaged in overtly communicative gestures or actions the students physically occupy themselves with a range of small scale, personal

actions and movements: fiddling with pens, rocking on chairs and tables and attending to hair or headscarves. The usual pattern at the site appears to have been for physical embodiment of meaning to be engaged in by the teacher rather than the students. These official meanings conveyed through the actions, gestures and movements of the teacher were instructional (e.g. directions to students) or informative (e.g. explanatory gestures). It terms of their function as semiotic resources, it is the teacher's movements and gestures which are most overtly engaged with as producers of meaning serving primarily to unify and direct the class as a whole. In contrast the students' personalised and small scale actions and movements described above function semiotically as markers of individualism and unique direction.

Written and visual texts are ubiquitous at the science site. These range from text books (in class sets of thirty copies) to students' exercise books, wall displays, health and safety notices and the temporary teacher produced notes and diagrams on the whiteboard. A great deal could be said of the semiotic significance of each of these, here, however, a few salient points only will be touched upon to create the sense of prevailing semiosis required by this survey. During the lessons observed text books were not formally used but were present in the room and available to students. Worksheets, however, were used, identical copies having been handed out to the students. A few features common to both the worksheets and the textbooks in science are worth commenting on; the prevalence of diagrams and drawings, the highly sturcutred (segmented, itemised) appearance of the written text and the relative absence of photographic images. None of the written texts appeared as large chunks of narrative and the majority of visuals were diagrams or cartoon style drawings. Colour usage was frequently encoded for a variety of purposes ranging from indication of a change in topic in the textbook to differing temperatures of water particles in a diagram. It was also generally mono-tonal in quality. The structure and organisation of the visual and written texts at the site does not evoke a concern with unique, one-off real life events nor aesthetics – if so we might expect narrative written texts, photographs, symbolic visuals and varied use of colour. Instead the textual features noted suggest a range of meanings associated with the study of science; they are carefully ordered and structured, tend towards duplication and are heavily concerned with interpretation. This was evidenced in the quantity of semiotic

material (such as diagrams and heavily structured written texts) displaying high levels of mediation and configuration of meaning.

The classroom displays (fig 3.3) include a large number of noticeboard type arrangements. Here texts with multiple pages are often attached at one corner only so that they can be removed, read and replaced. Varieties of text types are also positioned alongside one another in displays. In figure 3.3 the following text types can be seen grouped together on one pin board: newsletters, cut out newspaper articles, a pamphlet, a year planner and a student produced diagram. The mass produced texts, imported to the site from external contexts, create a visible link between the school science laboratory and the rest of the world. This selection in itself has the semiotic function of associating school science with the wider world thus validating the science lessons. The fact that a student produced diagram is placed alongside such authoritative wide-distribution texts is also significant. Although undoubtedly not an original or creative piece of work but a reproduction of a conventional representation, the fact that it appears alongside the authoritative, legitimate texts, gives status to the students as participants in the wider scientific community. Lastly the presence of the planner reinforces the centrality at the site of realisable, organised and accountable activity.

Fig 3.3 Semiotic Landscape: laboratory display board

Attention at the science site, should also be given to the teacher produced written texts, in particular those that appear (and disappear) from the whiteboard. At this site, as has already been noted, there is just one whiteboard. A typical use of the board is

shown in figure 3.4. Here, using three different colours and three separate columns the teacher has made three lists: the first heading is 'Learning Objectives', the second 'Vocabulary' and the third 'End of Lesson'. The two outer columns make use of bullet points. The vocabulary list does not, but is written in red (possibly indicating regular colour coding for vocabulary items to be learnt). The segmenting and organisation of the board is indicative of a range of underlying assumptions about what happens at the site: there are desirable, prescribed outcomes, uniformity is expected, there is order and classification, there is relative complexity and so on. Later in the same lesson the whiteboard was cleaned and the lists replaced with a diagram (see fig 6.3 on page 154). The whiteboard texts at the site regularly change; they are both verbal and visual, concerned with science content and science organisation. The whiteboard texts function semiotically in reinforcing the principle of purpose-led usage at the site.

Fig 3.4 Semiotic Landscape: science whiteboard

Prevailing patterns of meaning conveyed through spoken interactions also need to be accounted for. Below is an extract of teacher led input recorded during the first of the science lessons. It has been selected as representative of teacher talk at the site and comes from part of the lesson during which the teacher was demonstrating different techniques for the separation of mixtures.

T *Now finally then ...here's a mixture of sand and water.*

S *Why's all the sand at the bottom?*

{T *Why is all the sand at the bottom?*

{S *Shake it.*

S *Because its heavier.*

S *Shake it.*

T *Because it's heavier, so ...*

S *...particles, Sir.*

T *The particles are heavier.*

Now they're ... there is, that is one way of separating out two things when you've got a heavier part and a lighter part. Now this is called decanting. OK, this is called decanting and if you were very careful you could pour off this liquid at the top.

But who said something else over there?

S *Filter...*

T *Filtering it or sieving it ...*

{S *Yeah, I said that.*

S *Sieving*

{T *...depending on the size of the particles.*

{S *But Sir, won't it come out)*

{S *Sir, sir*

{T *... we could separate it*

{S *But sir, the sand comes in big blocks*

S *Sir, do you think you could distillate it?*

T *Yeah, so depending on the size of the particles at the bottom, will depend on which way we do it. You could distillate, you could use this method. OK, you could use this method. But much easier, it would be simpler, just to filter it.*

It can be seen that although the central thread of communication is maintained by the teacher it is frequently interrupted and redirected by interjections from the students which are not rejected by the teacher but accommodated into the dialogue. As a result he is often prevented from completing an utterance, the bracket symbol indicating two concurrent fragments of speech. Although the teacher is responsible for the only complex utterances, there is relatively equal distribution between the teacher and the students in terms of questioning and declarative statements. It is a student who first

asks why all the sand is at the bottom and a student who declares that the sand is 'in big blocks'. These spoken interactions appear to embody a level of ambivalence unique among the instances of semiosis at the site. Here there is little of the conformity, uniqueness of purpose and imposed directionality conveyed by other semiotic resources at the site. Rather there is unpredictable and individualised negotiation around the knowledge at issue in which the teacher and students are not clearly defined in terms of control (turn taking, changes of topic etc). In attempting to identify the meaning potential of this pattern of interaction, it was noted that it appears to belong to a knowledge hierarchy much wider than that of the immediate context of the classroom. A possible meaning borne out by the structure of this interaction is that the study of school science is to be located in a much wider social and cultural context where hierarchies of expertise are reinforced by the role accorded to science and scientists more widely in the media and so on. This being the case, the teacher is less a specialist in his own right than a conveyor of a greater truth and to some extent a participant with students in the greater endeavour of scientific investigation. As this fragment of spoken communication suggests, there are conflicting elements among the prevailing semiosis at the site. Such anomalies would usefully bear further investigation informed by, amongst others, Bernstein's concepts of democracy and pedagogic rights.

3.3.2 Findspot: Science

Having provided then, a background picture of the prevailing semiosis at the site, it is necessary to turn attention to the irregularities and uncommon occurrences of semiosis which led to the excavation choices of this research – the findspots. Here unusually high levels of semiotic activity were identified and patterns of production and distribution were seen to change.

During their involvement in the modelling task the students became engaged in the work of representing a separation process. In so doing they moved around the room and physically engaged with equipment and furniture in ways that were unusual and at odds with the prevailing practice. Physically, they arranged themselves differently as they worked on their model (see fig 6.3 on page 154) facing each other rather than the front of the room and sitting on both tables and chairs while working. Later, at the presentation stage, it was the students themselves who stood behind a desk facing the

rest of the class to explain how their models worked (see fig 6.2 on page 151). These bodily arrangements were at great variance with the prevailing practice. In addition it was noted that during representational activity students moved freely around and in and out of the room in the process of interacting with one another and searching for the desired materials. The teacher himself also moved differently during these stages of the lesson first positioning himself alongside the students as part of their groups while discussing their work then facing them during their presentation as a member of their audience.

Most significant at the findspot, however, were the students' representations themselves (see fig 3.5). They were different to other artefacts at the site in several important ways. Unlike the prevailing visual and written texts they revealed aesthetic considerations. They also used a wide range of colours not normally found in science (for example orange and purple) and importantly indicated authorship. While sharing many features in common with the uniform flasks and funnels in the laboratory cabinets, the equivalents in the student produced models were unique in shape and material composition – being more squat, elongated or curvy than the original items.

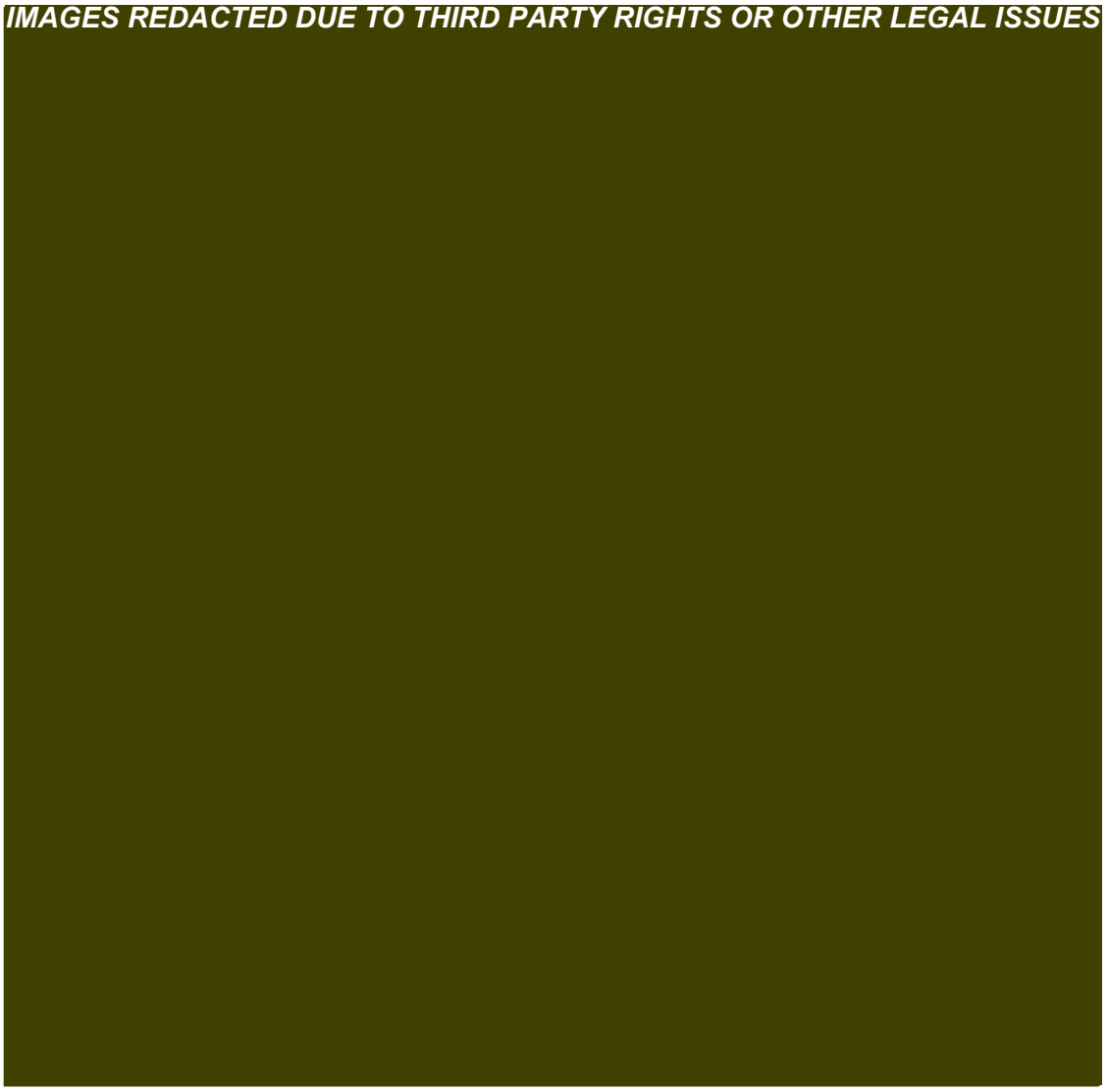

Fig 3.5 Science Findspot: students' multimodal representations of separation processes

A further variation from the prevailing patterns of semiosis emerged when the students came to present their models to the rest of the class. Here the students themselves employed the bodily movements, gestures and speech patterns usually associated with the teacher. In so doing, the usual distribution model of communication described earlier was, at least temporarily, disrupted. Significantly the students chose to involve all group members, not just one, to act as a kind of composite teacher. They positioned themselves in an area of the room from which information was not usually disseminated and provided explanations with only occasional interruptions from other class members. Indeed the power distribution of these enacted interactions was if anything *more* clearly defined than that of the real

life teacher / student interactions where the teacher led explanations were frequently disrupted by students' enthusiastic responses and participation.

The above mentioned features were significant enough in their difference from the prevailing semiosis at the site to warrant further investigation. Consequently a principal artefact was selected (the filtration model) and excavation at the spot initiated.

3.3.3 Prevailing Patterns: History

Fig 3.6 Semiotic Landscape: history classroom

It is immediately apparent from figure 3.6 that, what can now be termed the semiotic resources, are differently realised in the history classroom. Although both rooms contain the same kinds of utilitarian furniture and fittings, the history room is irregular in shape having a narrow section leading to the door and an area partitioned off with book cases at the back. It also has much higher ceilings than the laboratory (being in an older part of the building) and has a partially carpeted floor. It too has a

workbench running along one side of the room with cupboards below and there is a white enamel sink with regular chrome taps - items remaining from the room's original use for domestic science teaching. Unlike the science laboratory, there are a number of more domestic, comfortable, decorative items - an arm chair positioned by the book case and pot plants on window sills. The tables are also arranged in pairs but at differing angles to the front of the room. The teacher's desk is positioned to the side and at right angles to the class. The arrangement of tables at the history site also changes regularly – a horseshoe shape being equally common to that shown in the photograph. In both arrangements students face in different directions – not all towards the front. Outside the history classroom itself, but still an integral part of the site, is an unenclosed area on the landing used by students from the two adjoining history rooms. Part of the area is carpeted and there is a low table and easy chairs. This area has a recreational feel and is used regularly for small groupwork. At this site the semiotic resources of the physical classroom (its fittings and immediate surroundings) differ markedly from those at the science site. There is less regularity and conformity in the choice and arrangement of furniture and directionality is different affording a range of possibilities to individual students. The flexibility and frequency of change also conveys an opening up of possibilities rather than closure and certainty. A number of features, as has already been noted, are more commonly associated with domestic settings – soft chairs, partitioned areas and carpets. What is communicated here is the desirability of continuity with, rather than separation from, the students' lives. The suite of rooms and the ability to move from one area to another for particular activities creates a sense of space being used more freely and flexibly with the semiotic portent of intellectual space.

The acceptability of differing interpretations and individuality at the history site is further reinforced in the deployment of teaching resources. Here there is no white board but there are three chalkboards across the front of the room. These are used by the teacher to write up notes during lessons. Because there are three of them it is normal for several sets of notes produced at different times to be visible. Notes often remain on the board from previous lessons and they are likely to be written in a range of differently coloured chalks. This contrasts with the whiteboard usage at the science site where several texts appear and disappear in the space of one lesson. This utilisation of the chalkboard at the history site then is very different to that at the

science site where teacher produced texts with a specific purpose related to a precise stage of the lesson appear for a short time only. As a consequence students' interpretation of what appears on the history board is less subject to teacher control – the possibility being left open for students to use the notes made on the board in their own time and as best suits their individual needs. The use of chalk rather than a marker pen and whiteboard should also be noted – this non-utilitarian, possibly aesthetic choice is in itself an instance of semiosis; a signifier of meaning. What is strongly suggested by the deployment of these semiotic resources at the history site is an openness to the possibility of multiple realisations (rather than conformity with a single option) and the promotion of individual, unique perspectives.

Before moving on to record the instances of semiosis involving movement, action and gesture, it should be noted that the temporal rhythms of the school timetable and curriculum are as prominent at the history site as in science. In this sense both subjects are accorded similar status as temporal units within the overarching organisation of the school experience. Within this pattern, however, Science lessons, occur with greater regularity: there being four lessons a week in Year nine as opposed to just two of history. In addition, the continued occurrence of science lessons until the end of the eleventh year of schooling is a fixed feature of timetabling whereas history lessons only continue beyond the ninth year if selected.

Embodied meaning is generally less prominent at the history site than in science. The history teacher uses a more limited range of gestures related most commonly to instruction rather than explanation. Patterns and regularities of bodily movements, actions and gestures being less clearly observable, the relative absence of physically embodied meaning suggests a more intellectual knowledge culture. In spite of this the physical enactments of social relations at the site are shaped by identifiable regularities. The teacher moves around the room almost constantly and into all spaces in the room often in close proximity with the students. Here patterns of moving from one table to another are responsive as she reacts to student requests and hands out materials thus enabling students to progress with the task at hand. With the exception of initial input (delivered from the front of the room), the class may be addressed by the teacher from any point around the room, the teacher positioning herself where the students' needs can best be met. This kind of interaction, observed as exceptional at

the science site, is commonplace here. The students, meanwhile, are to a much greater extent, engaged with written and verbal texts than in science - their most common physical actions being related to their handling of stationery, textbooks and worksheets. Indeed a greater proportion of the knowledge at this site appears in these written texts than in science where spoken explanations and physical demonstrations are central to the teaching. Lastly, it should be noted that in spite of the apparent flexibility and freedom of physical activity at the history site, the students move only as and when directed by the teacher. The raising of hands for permission (to speak or for other requests) is widely and consistently used.

In addition to the collection of history books on the book case and elsewhere around the room, written and visual texts in history are present in multiple copies as text books, atlases and worksheets. Here photographs are commonplace as are long segments of narrative text or commentary. These features of the texts along with their quantity and variety suggest a knowledge culture engaged with a very wide range of unique one-off events and occurrences rather than stable unchanging features. There are few diagrams or other forms of overtly mediated visual representation, timelines being the most prominent of these. The quantity of displays at the history site, however – in the classroom, the adjoining area and along the stairs - is striking. The vast majority of these consist of students' work which has been selected, mounted and presented by the teacher. Their presence is, moreover, entirely in keeping with the stated objectives of the department – to validate all skilled analysis undertaken by students as the work of real historians. Conversely externally or mass produced material such as the newsletters, pamphlets and newspapers cuttings visible at the science site are not in evidence here. Instead, the students' work is accorded an equivalent status of authenticity and value having been carefully mounted and labelled. A typical example of such a display can be seen in figure 3.7. This consists entirely of student produced work on the Second World War. As visible in the photograph, a significant proportion of the visual images, are direct reproductions of officially recognised historical sources. Copies of the original documents, however, do not appear - it being the prevailing practice at this site to prioritise and value the history produced by students. These displays, however, unlike those on the science noticeboard (fig 3.3) are not to be touched or moved – being firmly fixed and often positioned out of students' reach.

Fig 3.7 Semiotic Landscape: history display

In terms of the patterns of spoken meanings occurring in history, the following extract of teacher talk and whole class interaction has been selected as representative of the prevailing pattern.

T	*What about another way of finding out about history? How do they write those books, girls? What other ways?*
S	*Artefacts*
T	*Now you in fact have seen artefacts from Benin because you went to the museum. Artefacts are incredibly important and a particular form of artefact that you saw... What was the one that really gave us quite a vision, specially about the Oba? There wasn't just one, there were lots of them. Come on now, think.*
S	*Plaques.*
T	*It's the plaques. You got a very good view there.*

It can be seen that the student / teacher spoken interaction is firmly within the control of the teacher. This is in spite of frequent openings made available for student response and input. The one word responses that appear above were slow in coming.

This time, unlike in science, the questioning is done solely by the teacher. Far from interrupting and redirecting, the students here are reluctant to participate in the discourse in spite of the teacher's invitations and exhortations. She is asking the students to think back to a prior experience – their visit to the British Museum – and to transfer that knowledge to the current site. The students, rather than responding to this opening up of the knowledge appear to close it off. As has already been suggested, a great deal more could be gained from careful analysis of these contrasting classroom interactions. For the purpose at hand, however, it will suffice to make the following observations. At the history site student talk is limited and occurs only with explicit guidance and prompting from the teacher. The teacher's spoken input, on the other hand, is extensive and largely rhetorical in function. There is an inherent contradiction here in the suggested knowledge culture characteristics – while there is a stated desire for students to participate actively, they display distinct reluctance to do so. The same contradiction is apparent in the department policy displayed on the landing (see fig 3.8). Here the strong sense of group identity and conformity is conveyed through the repeated use of 'we' and the stated objective of effective social participation. The statement, however, is anonymous and appearing in this form is suggestive of a higher authority. The desire for genuine critical participation appears, ironically, as a compulsion. Furthermore with its formal appearance and linguistic forms the statement, with the words 'We believe ..' evokes, if anything, a religious creed – the ultimate expression of conformity.

Fig 3.8 Semiotic Landscape: history statement

To summarise, empowerment and autonomy are key features of the history department statement and can easily be identified in much of the prevailing semiosis at the site. It has also been shown, however, that the semiotic construction of the knowledge culture here, as in science, is complex and even contradictory in its various realisations.

3.3.4 Findspot: history

It should now be noted how and where variations in the prevailing patterns of semiosis were observed in history and how these led to decisions concerning when and where to excavate. As has already been outlined in the first chapter (see 1.2) the multimodal representation of Benin City engaged students at the history site in ways that were remarkable because they appeared to differ from precisely the patterns and conventions outlined above. Firstly, the students were physically engaged in ways that were uncommon at the site – moving around the room to collect materials, positioning themselves differently around the desks and using frequent bodily gestures to convey meaning to one another. The quantity of student talk was also strikingly different to that which usually prevailed. After initial lengthy silences the students were almost constantly engaged in animated discussion for the duration of the lessons devoted to representational activity.

The visual texts the students produced were themselves remarkable for a number of reasons. As can be seen from the small selection in figure 3.9, they differed from one another significantly – unlike the identical worksheets commonly used or the displays of reproduced conventional history these were genuinely unique and the meanings represented entirely those of the students' own making. They also differed in the choices of material and form including three dimensional representations and the use of collage – each of these choices having been motivated by the students' own understanding and desired representational forms. Finally, unlike the regular classroom displays, these posters were movable and handleable being temporarily fixed to the top of the chalkboard during the presentation sessions. At these points students from both the presenting groups and the rest of the class physically interacted with the representations pointing things out, lifting flaps and so on. In short there was, during this particular activity, a dramatic shift in semiosis at the site from formal

conventional texts and predominant teacher-produced meaning to the students themselves who became verbally and physically active. All the evidence pointed to this as a findspot rich in semiotic artefacts and well worth further excavation.

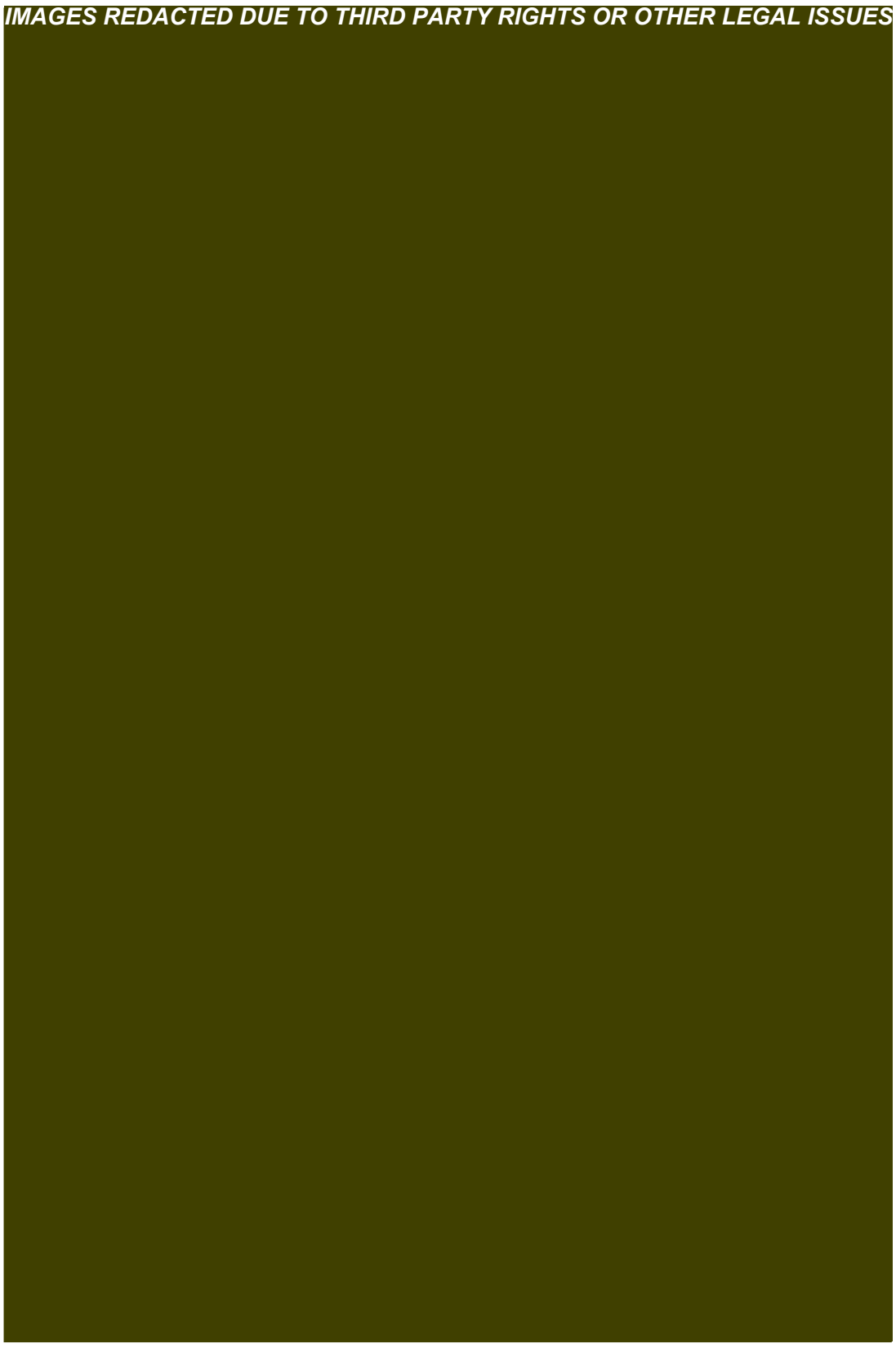

Fig 3.9 History Findspot: multimodal representations of Benin City

Chapter Four
Techniques and Tools

4.1 Introduction

In this chapter attention will be turned to methodology; the processing techniques and tools designed to extract from the artefact texts the evidence of learning with which this research is concerned.

4.2 Reflections on Data Collection

The data collection was carried out in two phases during a single academic year (September to July). In the first phase data was collected from history lessons and in the second from the science revision unit. In both cases data were drawn from teacher led input and students' independent work, presentation and post project group interviews. There were, however, significant differences in the quantity and diversity of material collected at each phase. Data from the history project, collected during the first term of the school year, was copious and diverse including material form the same unit of work undertaken by two classes taught in different rooms with different teachers. Material on four focus groups was collected; two from each class. In contrast, the science material collected at the end of the year after external examinations (Key Stage 3 Standard Attainment Tests), was selected according to the criteria of the emerging research design. On this occasion material was taken from one class only and from a single focus group. Responding to an opportunity that arose in the classroom, the composition of this focus group was the same as one of the history groups. This narrowing of the scope of data collection in science was partly expedient and partly shaped by the developing research design. Collection of the history data occurred during the earliest stages of research design whereas the science data was collected eight months later by which time the design was well established.

What will be discussed here are reflections on data collection common to both phases; history and science. In both cases the experience of operating as a researcher in a secondary school classroom raised a wide range of issues pertinent to the research project as a whole. An account of the data collection procedure will be given followed by brief discussion of the issues which presented themselves for

consideration most forcibly; the researcher's role in the classroom, ethics of data collection in schools, the use of recording technologies (their affordances and potential to distort) and finally the challenges of multimodal transcription.

4.2.1 The Data

Data collected at the two sites comprised the following: video recordings, sound recordings and artefact texts. Video recordings were made of the classroom environments and the actions of teachers and students. Separate sound recordings were made of students talking while engaged in representational activity and of the final post project interview. Texts featuring in both the presentation and production stages of the project were collected. After each lesson during which data collection was carried out, written notes and sketches were made. These included sketches of the classroom providing information which could not be easily obtained on camera (i.e. spatial arrangement of furniture) and written records of the researcher's impressions and reflections on particular incidents.

Video recordings were made with a hand-held digital camera. Classroom environments (and adjoining corridor displays) were filmed prior to the lessons. Filming during the presentation, teacher-led, stages of the lessons was done from the back of the classroom, the focus being on the teacher him or herself and the chalkboard or whiteboard at the front of the class. During the production stage, while students were engaged in representational activity in groups, filming alternated between hand-held footage of different groups around the room and fixed footage of a focus group at work during which time the researcher was able to move away from the camera. The periods of fixed footage were extended in the second phase of data collection: the science project. Data generated from the video recordings consisted of both still images (frame grabs) and transcriptions of speech and action.

In response to difficulties faced in obtaining clear sound recordings from the discretely held or positioned camera, a small tape recorder was placed on the table of the focus group among the materials with which they were working. The same technique was used to record the post project interviews. The quality of these recordings was, however, of variable quality for the students' representational activity

involved a high level of mobility. Although transcription of these recordings was painstaking, ultimately the data generated was of high value.

Texts collected from the sites were either removed in their original form or were borrowed and copies or photographs taken. In history, all relevant teacher produced resource materials were collected and copies of students' notes and work in progress made. Finally the original presentation texts were retrieved from the focus groups. In history, presentation texts from all groups in both classes were borrowed and photographed so that they could be returned for classroom displays. In science the texts collected included photocopied worksheets and the pages of a text book. In this phase it was also possible to retrieve the original presentation texts of all groups in the class. In both phases textual data was also collected in the form of images on the digital camera. These included temporary white and chalk board texts (teachers' diagrams and writing) as well as students' work in progress.

4.2.2 Role of the Researcher

During the collection of data the stance taken by the researcher was non-interventionist; there was no deliberate manipulation of events or stimulation of students.

On occasions the researcher's non-interventionist stance was compromised. It was necessary, for example, to respond to students' requests for feedback or to behave as a teaching professional when required. These situations occurred because the researcher was, at the time, employed at the school and was known to students and staff as a teacher. Given these circumstances, particular care was taken to introduce the research project to both teachers and students and to indicate that the researcher was, temporarily, taking on a different role.

The fact that the researcher was a member of the school's teaching staff held some disadvantages but was, in general, of benefit, not least in that the inception of the research project which was born out of a long term involvement with the school community concerned.

4.2.3 Ethics of Data Collection in Schools

The two groups of participants to whom the researcher had a responsibility were, in this case, the students and the teachers. Within the ethical framework for social research envisaged by May (1997), the stance taken for this research project approximates that described as 'open autocratic'. While protecting the participants' interests and keeping them as closely informed as possible about the nature of the project there were, as will be shown, areas in which the research objectives precluded a fully democratic approach.

Students and teachers were made aware that the focus of the project was representational activity and learning. Their consent was sought both to being filmed and to having their images appear in subsequent presentations and publications. One student requested not to be filmed and one teacher consented to being filmed for research purposes but not for the images to be more widely available. Other teachers and students, in particular the four students of the focus group, were comfortable with being filmed and for their images to appear. The students were thirteen and fourteen years of age at the time of filming. Consent for data collection was given by the head teacher of the school but it was not recommended that parental consent be sought. An information pack outlining the research design was prepared for the school's senior management and they were kept informed of developments throughout the year long period of data collection and research development.

In implementing the above ethical procedures the researcher was forced to acknowledge that the focus of the research – learning through engagement in multimodal representational activity – could not be communicated in terms that would be sufficiently meaningful to either the teachers or students. The extent to which their momentary choices of shape and colour, their fleeting gestures and utterances would become the basis of subsequent theorising could not have been anticipated. Strictly speaking the participants had given consent without being fully informed – hence the element of autocracy in the ethical stance. Indeed had the participants been given a fuller picture of these methods of multimodal analysis it is possible their actions may have been hampered. In spite of this slight element of necessary deception, the data was ultimately used only to fulfil the research objectives as communicated to the participants.

What could not have been predicted at the data collection stage was the extent to which the activities of particular participants would become so prominent. Although the four students of the focus group later expressed satisfaction at having become the focal point of the research, consent for this intensity of focus was not obtained prior to data collection. The extent to which the consciousness of these four young women permeates the entire study could not have been foreseen: their actions, their speech and their physical work is accounted for in great detail. Likewise the prominence of the science teacher's gestures and speech could not have been anticipated. The subsequent willingness of these participants can hopefully be interpreted as an indicator of honesty and openness in the researcher / participant relationship.

4.2.4 Affordances and Constraints of the Technology

The data collection was carried out during a period of very rapid development in digital technology. Digital camcorders and cameras were proliferating with increasing sophistication and dramatic lowering of costs. New software was turning video editing into a non-specialist activity and the storage and manipulation of digitally recorded images was becoming commonplace. Meanwhile the affordances of digital technology for multimodal transcription and analysis were being explored and developed from the Multimodal Corpus Authoring (MCA) system of Baldry (2004) to the transcription of visual and audio aspects of multimodal interaction by Norris (2004) and the analysis of technologically mediated learning by Jewitt (forthcoming).

None of the above research, however, was available at the time of the initial data collection. Consequently the methods developed here were ad hoc being driven by the immediate requirements of the research question. Not only was there a compelling need to record the elusive embodied modes of action, gesture, and speech; it was also necessary to re-format the conventional visual and written texts for integration into computer mediated text such as this.

The video recording of teacher and student actions and gestures was the area in which the data collection process benefited most from the affordances of the technology.

Still images could easily be obtained from the video footage and imported to other contexts. The technology was thus able to provide, for future analysis, a permanent record of specific momentary actions, gestures and movements deemed significant in the light of the research question. What proved more difficult was the recording of sound. The camcorder's interior microphone was adequate when recording the isolated speech of an individual (i.e. talk by teachers or students during presentations) but could not simultaneously record the visual and audio elements of the focus group's representational activity. When positioned to film the whole group at work the camera was too far away from the group to pick up their relaxed and informal spoken interactions. Moreover there was a high level of ambient noise in the classroom as other groups of students continued their own work in a similar fashion. No external microphone could be found with a long enough cable to be safely used within the confines of the classroom. The analogue sound recordings that were finally made using a small battery powered tape recorder were not of a high quality. An altogether more technologically advanced approach to the sound recording would have been desirable. A digital soundtrack, for example, could then have been manipulated in the same way as the visuals – with sections imported as sound clips to other digitally mediated texts.

Although original written and visual texts were collected whenever possible it was only with the aid of digital technology that these could be integrated into the text of the description and analysis. In this case the software made it possible to manipulate and transport digital recordings of visual and written texts. This proved useful in tracking semiosis where digital images of, for example, history artefact texts could appear alongside students' photographed actions and written transcriptions of their speech.

4.2.5 Video Camera Impact

Responses to the presence of the video camera were interesting, varied and worth commenting on in their own right. Although it was used as discretely as possible to minimise its distorting impact on the participants' behaviour, no attempts were made to conceal the camera. In this respect the researcher subscribes to the position taken by Lomax and Casey (1998) regarding video methodology; that covert filming is

undesirable and that the camera should, rather, be embraced as another element of the social context from which the data is extracted.

In general the teachers were influenced more by the camera than the students. Given the prevailing culture of teacher accountability, performance management, school inspections and the thorny political issues these practices raise, the teachers were understandably cautious. In spite of the researcher's best efforts to allay conceptions of filming as a forerunner to the passing of judgement, the belief that any record of teacher activity would ultimately be used to evaluate persists. That such perceptions are so widely and justifiably held can only be detrimental to educational research – a consideration that must be borne in mind as the culture of performance and targets continues to be foisted on schools. In spite of this counter-productive context, however, the experience of one teacher in watching themself on film was deemed sufficiently useful for videoing to be recommended to the department as a tool for personal reflection and professional development.

The response of the students to the presence of the camera was in direct contrast to that of the teachers; most of them wanted to be filmed. Particularly during the early stages of filming there were instances of students manoeuvring themselves in front of the camera and performing for it with flamboyant gestures or colourful language. Others took an interest in observing their class mates 'on film' by taking up positions behind the camera. Other students, in particular those of the focus group who were being filmed directly experienced a short period of awkwardness characterised by long silences and laughter before they got used to the presence of the camera and became absorbed in their tasks. Although the impact of the camera on the students was initially distorting it appears to have been, on balance, a positive, even celebratory presence in the classroom. Video recordings of the presentation lessons were made available to the teachers and then shown to students to facilitate reflection on their presentation skills. Video recordings of the teachers themselves were loaned to them for private viewing.

4.2.6 Transcription Challenges

> 'The challenge remains for us to capture and analyse choices across all semiotic resources in such a way that the dynamics of meaning-making can truly be investigated.' (O'Halloran, 2004)

Responding to this challenge, it was necessary, having amassed a quantity of multimodal material to find methods of transcription that would indeed 'capture' the inherent choice-making. Of particular importance were the choices made by students while engaged in their representational activity. It was necessary, then to transcribe this activity (in all its modes of semioisis) in such a way that actions appeared as selections. In order to do this, initial transcription made use of every piece of material collected to build up as full a picture as possible of the semiotic environment. This meant transcribing semiotic material as diverse as displays on the classroom walls and fragments of students' spoken interaction. It needed to take into account both space and time based modes, embodied and disembodied modes (see Norris, 2004). In this sense the only full transcription existed in the researcher's mind where awareness of temporal events (speech, gestures etc) and the sight of visual and spatial manifestations could all be held in juxtaposition. In order to consolidate this mental transcription considerable time was spent listening to, watching and examining the collected material. As part of this process an undertaking was made to conventionally transcribe to as great an extent as possible. Engagement in this process consolidated the mental transcription and led to the creation of a new artefact text; the written transcription; itself a product of transduction across modes. In attempting to gain as full a picture as possible of the different semiotic modes co-present during representational activity the format in fig 4.1 was used. Here the written transcript includes every spoken word that could be identified from the audio recording. Each spoken fragment is attributed to the relevant student and annotated to indicate pauses, simultaneity of speech, emphasis and so on. In the right hand column the co-present embodied meaning making is described in words. Production of this element of the transcription necessitated short extracts of video footage to be reviewed over and over again to ensure the actions and gaze of different students were correctly matched with the co-occurent speech. This process also aided transcription of the audio tape in which it was not always possible to identify the speaker. At the end of the painstaking process of focused listening and watching it was necessary to choose words for the written transcription which would most accurately recreate a perception of what the

action entailed (for example the 'that's finished' gesture). These were often little more than memory triggers for the researcher – the transcription being a tool rather than a product for wider consumption. This transcription demanded a level of engagement with the data not achievable by merely viewing the tapes. Ultimately, in tracking semiosis, still images of gestures (rather than their verbal transductions) were reinstated. It was only in the process of becoming immersed in the written transcription, however, that the significance of particular instances of semiotic activity emerged. This could, in part, be a tribute to the effect of the researcher's own representational activity (transductional in nature as was that of the students themselves) in re-shaping knowledge about the phenomena at issue; the researcher's own learning.

Time	Talk		Action
	A	What is this?	D is leaning over plan colouring.
	D	Open roof house	A rests head in hands, elbows on table.
	A	I know but what is that?	B leans across table resting head on elbows.
	B	Oh. That's the king's castle.	
	A	Eh?	
	B	The king's castle.	D finishes colouring the purple outline, replaces the lid on the felt tip, brushes hands together in a 'that's finished' gesture, sits down and blows the felt tip ink on the sheet.
	(4)		
	A	We could have a main street like	
	D	What colour's the courtyard?	D gaze to A.
	A/B	( )	
	D	What colour's the courtyard?	D reaches across and nudges B who is looking down at the plan. D taps the courtyard position on the plan with her forefinger.
	A/B	( ) should be the garden ( )	
	(2)		
10.35	D	I'm going to colour it in because I can't draw	D picks up felt tip pen, removes lid and makes a 'don't blame me' gesture with hands apart.
	B	Just write it in courtyard first.	B stands up and moves round table to D, picks up pen and positions body alongside D.
	D	What do you mean write it in pen?	D reaches across table for rubber; B hands it to her.
	B	Because we have to like you know label that side	B makes 'position' gesture with pen in hand.
	D	Yeah I know I will do. I'll colour it in then I'll go over it in black biro.	D rubs out something on sheet.
	B	So what shall we do about the main road?	C dusts something with hands from her end of the sheet. She has been colouring in 'forest' on edge of sheet.
	A	They should come up from here and then um like ( ) split like one of the roads can go to the ivory district on that side and the other one can just join in with the main road.	A is seated gaze to plan on table, gestures with hands. B stands leaning over table, picks up sheet to refer to.

Fig 4.1 Transcription Extract: students' representational activity in History

It was in the process of producing this transcription that the salient choices began to emerge; the repetition of key words and phrases or the reoccurrence of certain gestures that could be traced and linked to other phenomena across modes. In this way the difficult choices were made particularly apparent but also the ease with which other representational activity was undertaken. The following incidents, for example, once accounted for in the transcription extract above (fig 4.1), could be identified as evidence of choice-making: student A colouring in for five continuous minutes, the choice of green for the colour of the courtyard, discussion about the use of 'biro' (ballpoint) for the label and the recurring discussion about the destination of the roads. Identification of such choice-making made it possible to map out the tracks of semiosis in a fully mediated transcription on which analysis could be based.

4.3 Developing the Methodology

Following the contrasting experiences of constructing a theoretical frame and collecting raw data in the classroom, the task of developing a data analysis model to unify and direct the research presented itself with some urgency. Far from being straightforward, this undertaking required a significant shift in thinking in order to develop new ways of seeing – to transform familiar classroom activities into theoretically relevant data. What follows is an account of the shaping and re-shaping of ideas which culminated in a set of techniques and tools which constituted the methods of data analysis.

4.3.1 Engaging With the Task

In conceptualising the task outlined above, Bernstein's position in 'Research and Languages of Description' (Bernstein, 1996 pp 134 – 144) has been influential in a number of ways. It is a common theme in work on ethnographic style qualitative data collection and analysis that interpretation (a more frequently used term than analysis) is built in to the whole enterprise from the very start – that even apparently neutral acts of data collection are imbued with theory. Particular emphasis is often placed on the *writing* of data as an interpretive activity, that 'truth is a textual production' (Denzin, 1998). The term 'thick description', (Geertz, 1973), is used for such interpretive texts which, beyond reporting material facts, also account for their intentions, organize them in to categories and contextualise in such a way that claims are made to the validity of a particular set of relationships. 'Thick description' in this

sense does not analyse overtly but does so through its textual functions; hence the prevalence of commentary on the process of research *writing* (for example Lincoln, 1998). Bernstein, on the other hand, not only expounds the fundamental importance of the language of description but also stresses the importance of making explicit its formulation. In his words the 'language of description ... consists of rules for the unambiguous recognition of what is to count as a relevant empirical relation...' (ibid.). It is to the rules from which the language of description originates that Bernstein would draw our attention. Such foregrounding of the analytical goes much further than merely accounting for the ideological forces which shape interpretive writing. In Bernstein's research process the overt development of a language of description is a means of exercising control over the data. He suggests that research without an explicit analytical model remains limited to perceptions located in the specific context – for example to perceptions of the participants themselves. On the other hand qualitative research which attempts to make use of 'off the peg' analytical tools is also unsatisfactory. Each research project has its own unique criteria for what is empirically relevant and generates complex, multi-layered and extensive material unsuited to imported analytical methods. The analytical model has to consist of specialised tools with which the researcher can work towards the chosen purpose.

In 'Research and Languages of Description' Bernstein stresses the importance of accounting for the origins of the language of description in order to explain and justify the analysis so as to position it in relation to alternatives. He cites the popular use of the concept of *habitus* as an example of a widely used social science descriptor isolated from its origin. Consequently it is known only by what it gives rise to, and brings, or does not bring about. Because there is no description of its origin or formation, parallel concepts can not be inserted in its place in order to establish boundaries and relationships. It follows then, that the task of *accounting for* the development of a language of description should be given particular status. Ultimately Bernstein is recommending a reordering of the hierarchy of the research process in which the meta processes are brought to the fore and specific particularities not given undue prominence but positioned in relation to higher order generalisable concepts.

In Bernstein's model of the research process two 'languages' are used – the internal language of description (L^1) and the external language of description (L^2). It is useful

to think of the L^1 and L^2 as languages in both the literal and the metaphorical sense. Literally, as languages, they employ different vocabulary and grammar for describing phenomena. Metaphorically, as languages, they differ in that they are spoken by different groups, require translation from one to the other and constitute different conceptual organisations of the world. The L^2 is located at the level of the participants and is the language of enactment – what can be seen by the researcher. The L^1 is identified with the workings of the culture and is the language of explanation describing how what can be seen was constructed. It is the L^1 that is most obviously shaped by the researcher's theoretical perspectives and this language in particular that needs to be accounted for.

In the case of this research project there are several factors which have given Bernstein's position particular resonance. Firstly the project has entered a relatively new field of study – social semiotic analysis of multimodal texts in an educational setting. Few pre-existing analytical tools are on offer. The systemic functional linguistics model of Halliday (1985) has indeed been reworked to apply to multi-modal texts (Kress and van Leeuwen, 1998) but there has been little theorising around the production of multimodal texts as a *function of knowledge-making,* the work of Kress, Jewitt, Ogborn and Tsatsarelis (2001) on science classrooms being a rare exception. Secondly, this research deals with particular classroom situations with which the researcher had, over a number of years, developed a blinding familiarity. In such circumstances the advantages of ease of access to extensive research material were counteracted by the difficulty in viewing such common place, taken-for-granted activities and objects as empirically relevant data. It has certainly been borne out that the research material gathered is precisely of the complex, multi-layered and extensive nature identified by Bernstein.

Once intellectually freed to give full attention to the development of an analytical model, the usefulness of engaging with this process became increasingly apparent. The emerging model resolved ambiguities, established boundaries, revealed categories and generally had an ordering effect. It transformed actions, occurrences, events and artefacts in to empirically relevant data endowing the research with validity and potential for reapplication. It has certainly been the case with the material collected for this research project that reorienting towards the meta processes

(languages of description) in line with Bernstein's recommendations did indeed invigorate the material endowing it with 'data-like' qualities well beyond its immediate context.

4.3.2 The Interface Between Theoretical and Situated Viewing Positions

The satisfactory conceptual juxtaposition of theory (the L^1 of culture) with context specific phenomena (the L^2 of enactment) is a pre-requisite for the development of techniques and tools for analysis. In this case it was the function of the theoretical viewing position to make apparent instances of learning arising from sign making (representational) activity. Meanwhile it was the function of the situated viewing position to bring in to focus the precise enactments – the physical and material texts and text-making practices of the subjects themselves. Conceptually the two are far from one another. In the words of Geertz:

> 'Our double task is to uncover the conceptual structures that inform our subjects' acts, the 'said' of social discourse, and to construct a system of analysis... (which reveals) what is generic to those structures.'
> (Geertz, 1973, p 163)

Although successful and productive juxtaposing of 'conceptual structures' and 'subjects' acts' later appeared natural and fitting, the initial manipulation of perception required by this exercise was an intellectually strenuous exercise. This was partly due to the rigidity of the ways of seeing established by repeated exposure to the phenomena under investigation (the blinding familiarity referred to above). It was also due, in this case, to the highly abstract (often contentious) qualities of the concepts underpinning the theoretical frame – for example understandings of 'learning' and 'text'. Nevertheless it was necessary to map the theoretical frame onto the specific site of research in order for the project to proceed – to facilitate the development of techniques and tools for data analysis. The challenge was to find a suitable viewing position from which both the theoretical and the contextualised perspectives could be held in focus. Only then could the two contrasting ways of seeing and their accompanying languages of description be brought in to a variety of relationships that could be judged according to relative analytical relevance.

In order to render this dual perspective possible it was helpful to re-cast the research question in a variety of ways using different terms and levels of generalisation. From

this exercise the following phrasing and concomitant perspective was found to be most serviceable: *'What did the students do with what they had?'* Remarkably, reducing the research question to such near banality was found to be very productive. The verb 'do', being applicable to a wide range of activities could equally well be used to refer to visible physical activities as well as to the theoretical interpretations of such tasks. For example a student could be said to be 'doing' label-writing but could also be said to be 'doing' (simultaneously) a configuration of a narrative process. Similarly the expression 'what they had' could be applied at both levels. Students could be said to 'have' a diagram in a text book but could also be said to 'have' (simultaneously) an analytical representation of how one part of the world of science is configured.

4.3.3 The Situated View

The theoretical viewing position could only be of use alongside a clearly focused, detailed view of the phenomena at the precise research location. It was this situated viewing position which established the enactments and phenomena available for theorising. Without the situated view, theorising would not have been possible. Moreover it was important that the two viewing positions remained conceptually detached so that relations *between* them were possible. Underlying this understanding of the research process is a belief that the theoretical viewing position in some sense transforms the situated view of raw data in to empirically relevant data. For this transformation to occur the situated view must not merge with the theoretical view. To apply Geertz's term, if the 'thick description' begins at too early a stage, the range of theoretical possibilities is prematurely limited. If, on the other hand there is a clear attempt to obtain unrefined quality and significant quantity in the raw situated account, then the usefulness of the theorising can be maximised. In conceptualising the status of the situated view, Geertz's term 'thin description' and Bernstein's L^2 are brought to mind. In both cases descriptions are accounts consisting of sets of facts – records of physical actions with no accounting for context or intention. Although no account, as has been suggested above, can ever be *entirely* unshaped by theory, such 'thin descriptions', focusing as they do on the physical and temporal are as far removed as possible from that which has been fully theorised. It is the contention here that it is precisely this kind of 'thin description' which needs to be brought in to focus first if the subsequent theorising is to be successful in generating new insights.

The quantity and detail of such accounts can only render them more useful. The greater the quantity of such detailed unprocessed data, the greater the possibilities for reordering, categorising and grouping and the greater the likelihood of new perspectives emerging.

It was in the endeavour to produce a situated view of precisely this quality that the artefacts, actions, events and occurrences at the two learning sites were accounted for in the detail and quality which is evidenced here. Accounts were kept as free as possible from interpretation, with the focus instead, on the physical and material – what was visible, audible and tangible. Accounts were given in as much detail as possible - impulses to select being resisted whenever identified. Visual and written texts were collected and described, audio recordings of speech transcribed, video recordings of speech and action also transcribed and events noted. The result was an extensive collection of material ranging from that which had been lifted directly from the site (for example written texts) to that which had, of necessity, to undergo some form of mediation (for example written transcriptions of recorded speech). Only by trawling this sea of material from the situated viewing position did data-like patterns and categories start to emerge. These early, entirely situated, context-bound 'thin descriptions' served no purpose alone; their function being to render visible the phenomena to be viewed theoretically. Consequently much of the content of the situated account does not appear in the thesis having played its role at this early stage.

4.3.4 The Theoretical View

The stated aim of the research was to find out more about how learning arises from engagement in representational activity. According to the theoretical frame (see 2.4) there are internal intellectual knowledge-constructing processes mediated by signs and shaped by social and cultural practices. This theoretical viewing position required students' representations to be viewed as evidence of their relationship to that which was to be represented or known. In addressing the re-cast research question: *'What did the students do with what they had?'* this theoretical perspective produced answers of the following kind: The students 'had' *a culturally imposed division of real life events and occurrences into subject areas, a story of the past centred on Western European agency* and *a set of criteria for the identification of a 'scientist' and a 'historian'*. The students 'did' *evaluating, finding boundaries, according status* and

rejecting or distancing themselves from etc. The language of this theoretical perspective is no longer that of visible and tangible artefacts and events. Such answers, instead, seek to account for the invisible shaping of students' learning. In short, the situated phenomena needed be identified, beyond their physical and material manifestation, as sites of learning. The question of *'what students did (with what they had)'* needed, in theoretical terms, to identify the *functions* of the situated enactments of the subjects – their speech and actions. It also needed to account, not only for the students' orientations, aesthetics and values - their 'interest' (Kress and van Leeuwen, 1996) - but also those of the teacher and other voices in texts books, displays and school conventions.

With the juxtaposing of the viewing positions outlined above, patterns started to emerge - frequencies, groupings, interrelationships and other ordering principles were noted. It is from this broad overview of trends and patterns that the analytical model – the techniques and tools - were developed. The reasons for engaging with this process from such a distant starting point are twofold. Firstly the resultant techniques and tools, arising, as they do, from the specific theories and context of the research project, are more likely to prove effective. Secondly, such involvement and reflection on the origination of the methodology not only affords greater possibilities for further refinement but also enables a stronger sense of positioning in relation to alternative interpretations.

4.4 Techniques and Tools

Each of the following techniques and tools has been designed to meet the stated objective of the study; to reveal the learning inherent in students' representational activity. According to the theoretical position, all representational activity is the result of motivated choice-making. What is required, then, is an account of the choices from which the students' representations result. As such, all techniques and tools concern the choices available to students as well as their responses. Only by providing this context has it been possible to interpret students' representational activity as evidence of learning.

Arising from both the theoretical viewing position and the situated account of phenomena at the sites, three tools have been developed to uncover the learning

inherent in students' representations. These techniques and tools select and juxtapose features of the artefact texts and accompanying material according to specific criteria. In so doing patterns and regularities emerge from which evidence can be drawn. Above all it is evidence of learning with which this study is concerned; both the specific subject content at the sites of the study and the more general patterns of knowledge development through engagement in representational activity. Most important of these methods is the tracking of semiosis; a technique designed to create a longitudinal view of semiotic (representational) activity. This technique reveals the development of students' representations from their origins; in particular the resource texts used for teaching. Once established, this relationship between resources and students' responses is used to examine specific elements of representational choice making. Thus tracking semiosis facilitates further analysis by organising the data according to choice-making principles. Two tools have been developed for this further analysis; the charting of representational processes and the mapping of representational modes. The first of these charts the occurrence of representational processes in order to explore differences and similarities between the resource text representations and those of the students. Because different representational processes configure information differently, this serves to reveal the students' underlying perceptions of the knowledge at issue. The second tool to be applied to the tracks of semiosis is the mapping of representational modes. Here resource text modes are compared with those used by students thus making it possible to identify commonalities and shifts in distribution of meaning. This tool also serves to pinpoint instances of transduction – the transfer of information from one mode to another. Changes to knowledge incurred by such transduction and the opportunities afforded for experiencing meaning differently can then be explored.

4.5. Tracking Semiosis

Semiosis is here synonymous with all kinds of representational activity. Wherever meaning is present semiosis occurs and there are few environments more overtly concerned with meaning than the classroom. Every image, text, physical and bodily arrangement, action and movement consciously or unconsciously embodies information not only about the subject of study but also about how knowledge and those engaged with it are socially organised. Classrooms are enormously rich in

semiosis. This being the case, the principles for organising data concerned with classroom semiosis need to be particularly clearly focused.

Because this research is ultimately concerned with learning – a change in one's status and identity as a knower – it is also characterised by a focus on transformation. The students' texts are only evidence of learning in so far as they represent change; new and unique forms of the knowledge in question. As such it is essential that a longitudinal view of students' representational activity be taken in which the students' texts appear as transformations; stages in a sequence of change related to what has come before. Such a longitudinal view also serves the purpose of opening up representational activity as choice-making. In the process of transforming the resources in to their own representations students made a number of motivated choices concerning what was available. As a result of these choices they created their own unique versions. The significance of this uniqueness is born out by the variety of output texts - in the case of the Benin City history project very different group texts were produced from the same input (see fig 3.9). What shaped and informed these different representational choices is what is at issue here. First, however, the choices themselves need to be laid bare. Only by viewing the principal artefact texts directly alongside other instances of semiosis (both resource texts and those produced by students engaged in representational activity) do the choices become apparent. The objective is to reveal the decisions students made concerning their representations. These choices, which lie at the heart of semiotic activity, need to be understood from a longitudinal perspective; not only should the students' choices be made apparent but also what was available to them. Tracking semiosis, then, is concerned with two things; the representations available to the students and the choices they made in response to them.

4.5.1 The Framework

The framework that has been devised for tracking semiosis needs to be understood as a device for opening up rather than limiting interpretation of the data. That the identification of boundaries (or frames) can provide fresh insights into apparently familiar situations is a well established theoretical principle. This is contrary to the popular perception of boundaries as enclosing or limiting. By identifying categories and structures both Goffman (1974) (in relation to wider social sciences) and

Bernstein (1996) (in relation to the study of pedagogic practices) have shown how commonplace every day events can be usefully theorised. It is in this spirit that the framework for tracking semiosis is employed here.

> 'I assume that definitions of a situation are built up in accordance with principles of organization which govern events (...) and our subjective involvement in them: frame is the word I use to refer to such of these basic elements as I am able to identify' (Goffman, E. 1974, p. 10)

It is to reflect such principles of organization that the tracking semiosis framework has been devised. In relation to Bernstein's work these principles are most closely related to his conception of classification; the 'defining attribute not of a category but of the relations *between* categories'. The divisions and boundaries apparent in the grid-like presentation of the tracking of semiosis are not, then, to be viewed as defining or limiting but as illuminating principles of organisation and relations. It remains necessary to explain the divisions and boundary markers of the tracking semiosis framework.

Each instance of tracking semiosis appears in the form of a grid. With regard to the science project (concerning filtration) there are five grids, in relation to the history project (concerning the ancient city of Benin) there are six. Each grid, then, already embodies a selection of text types. The principle of organisation employed here concerns the typology of representational processes described in chapter five. This chapter illustrates, with specific reference to the principal artefact texts, how a single text is the embodiment of a number of representational processes. The filtration model, it is shown, is primarily a narrative representation embedded within which are a number of analytical, classificational and topographical processes. The Benin City plan, likewise is primarily an analytical representation consisting of numerous analytical and symbolic processes. By taking these different representational processes as the organising principles for the tracking of semiosis, the result is a view of the data which is not only longitudinal but also a cross-section focusing, as it were, on a single layer. Consequently all texts appearing in the same grid have in common their relatedness to a single representational process. The following example (fig 4.2) deals with the analytical process in relation to the representation of particles. As such *all* the texts on the grid concern the analytical representation of particles; the criterial characteristics of which they consist. Other information about particles found in the

representations (such as their categorisation) is not at issue here. This information is presented for consideration in another grid concerned with classificational processes.

Although each grid concerns a single representational process, significant variation exists between grids relating to semiosis at different sites. In general the grids concerning the science project contain relatively small numbers of texts. By contrast, some of the grids concerning the Benin City project contain a much greater number of texts. In the case of the symbolic attributive processes in representations of Benin City (fig 4.3) the quantity of relevant texts is, for example, particularly great. In spite of these differences, the same principles apply; each grid deals only with a single representational process. In addition to the difference in quantity of content, the grids also vary in terms of pace. The science project spanned four one hour lessons taught over a two week period. The duration of the history project, however, was much greater - two lessons a week for four weeks. Both the input and making phases of the science project lasted for one and a half lessons. The time lapses between lessons, consequently, were fewer than in history and opportunities to reflect, discuss and revise limited. Pervading the science project (through teacher input and awareness of time limitataions) was the need to prioritise; to complete the work and meet a deadline. This urge to complete was absent from the history project until the final stages. Here the emphasis was on accuracy and quality with input from the teacher relating mostly to content of the students' representations rather than their completion. The respective grids, then, relate to tracks of semiosis which are characterised quite differently.

IMAGES REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

IMAGES REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

4.5.2 The Content

All tracking semiosis grids are segmented in to three parts: resource texts, representational activity and presentation text. These frames reflect the conjunction of theoretical principles of organisation and real life ordering of events. As has already been noted, the primary function of tracking semiosis is to lay bare, for further analysis, the choices inherent in the students' text making. As such it is necessary to show what choices were available to the students. The category 'resource texts' fulfils this theoretical requirement. It also corresponds, in real terms, to an identifiable group of texts occurring at a particular stage of the teaching and learning process. These are the resource texts provided at the beginning of the learning sequence which take the form of direct teacher input and teaching texts such as worksheets, textbooks, diagrams, information cards etc. This being the only organising principle of the category, the texts contained therein are extremely diverse in other ways. They range from fragments of teacher talk and temporary sketches on a chalkboard to textbook diagrams and reproduced historic illustrations. Some of them concern the subject content at issue, others the organisation and presentation of that information. In figure 4.1 for example, the first category of texts includes teacher's gestures, teacher's speech and a diagram on the whiteboard. All of these concern the analytical representation of the criterial characteristics of particles. In order to facilitate reading of the grid each item included in the resource texts section appears under a heading in bold print (for example 'Teacher's demonstration' and 'Whiteboard diagram'). This provides information concerning the context of production of the text concerned. It should also be noted that in order to segment and organise the texts according to these principles it has been necessary to mediate their production. Spoken resource texts have been transcribed from the sound recordings and are shown in italics. Actions, gestures and predominantly visual texts have been photographed and presented in a uniform size format. Written texts have been re-typed directly in to the grid (with no attempt to reproduce font, spacing or other visual features). In spite of this wide range of text types and variable levels of mediation, the underlying principle of organisation remains in tact; all texts shown in the 'Resource Texts' section of the grid were made available to students for their subsequent representational activity.

In all semiotic tracking grids the second segment is entitled 'Representational Activity'. The content of this segment is selected for one purpose only; to provide evidence of the students' engagement with the work of representation and thus reveal instances of choice-making in process. Much of what appears in this middle segment is abandoned, changed or invisible in the final text. Here are included rough drafts, fragments of discussion between students recorded as they worked on their representations and relevant excerpts from the post project group interviews. The last of these provide retrospective accounts by the students themselves of how they reached design decisions concerning the representational process at issue. Photographs of the students at work are also included here as evidence of their physical engagement with representation. For example in figure 4.2 the students are seen comfortably seated, eyes focussed on their work as they create their model particles out of cotton wool and paint. This evidence coupled with their dialogue presented in the same segment suggests that the physical, sensory experience afforded by the material in question plays a large part in shaping their choices with regard to the representation of particles. The post project group interview, on the other hand, is evidence of an otherwise invisible influence on their choice making; the perceived importance of conforming to the norms of scientific representation as acquired form their experience of science text books.

It is true to say that the 'Representational Activity' segment of the tracking semiosis grids contains the most disparate data – nor is there a unifying time frame. Evidence of representational activity is taken from a range of lessons during which students were at work (in the case of the Benin City project this period spans a much longer period of time) and from interviews conducted well after the work was deemed to have been completed. In any given grid the contents of the Representational Activity segment all concern the students' engagement with the process of production with regard to the single representational process at issue in that specific case. In figure 4.2 the segment contains three items; a fragment of student dialogue from an early stage of their work, a photograph of the students making model particles from the following lesson and an extract from the post project interview conducted several weeks later. Again it is the organising principle alone which unifies these disparate fragments of data. The usefulness of this principle can briefly be exemplified with reference to the Benin City grid which deals with representations of topological processes: figure 4.3.

Here the organising principle positions the 'rough sketch from written evidence' alongside a photograph of students making walking gestures with their fingers and discussing the purpose of having roads. By grouping these disparate pieces of data the organising principle brings to light the main criterion upon which the students' choices concerning the representation of the roads is based; the need for the roads to go somewhere. Ultimately the roads as represented on the rough sketch were rejected for failing to meet this criterion. It is the data in this middle segment of the tracking grid which reveals most clearly what the students accepted and rejected from what was available to them; what they foregrounded and what they reshaped – in short the representational choices they made.

The final segment of the tracking semiosis grids complies to a greater extent with the real life organisation of events as referred to earlier – it contains the final version of the students' text as presented to other class members and therefore deemed, for the context, to have been finished. Hence every Presentation Text segment in grids dealing with representations of filtration contains either the students presenting their model or a close up of some component of the model. Every Presentation Text segment in grids dealing with representations of Benin City contains the finished poster and, in some cases, particular details from it. Where the close ups or details are shown they correspond to the organising principle in terms of the specific representational process at issue. Hence, in figure 4.2 the close up is of decontextualised model particles (with a pencil to indicate size). The rest of the model and the students' presentation are not at issue here; the concern is with the characteristics of the model particles alone. Where relevant, extracts of speech from the student's spoken presentation have also been transcribed in this segment. In figure 4.3 an enquiry from a fellow class member and the students' spoken and gestural responses to it have been transcribed and shown in photographs. The class member raises a point about access to the palace via the courtyard where there appears to be no wall. This is a direct challenge to the students' now established criteria of needing to protect the king and queen. They defend the validity of their representation indicating with speech and gesture the presence of a wall preventing such access. The occurrence of such interchanges during presentation of texts was rare but has been included in this segment of tracking where relevant to the representational process at issue.

There is a sense in which the grids designed for tracking semiosis correspond to a time based input-output model. What appears in the first column precedes chronologically that which appears in the final column and is material from which the end product is made. The middle column corresponds to the processing of input. Unlike a standard input/output model, however, the framework is not exhaustive. It can not, and does not attempt to show *everything* with which the students worked to produce the end texts. Each track, then, is a snapshot of how some semiotic transformations and transductions operate rather than a representation of the process, (were such an endeavour possible), in its entirety. As a result of its targeted focus, the format is able to show what the students did with specific resources that were available to them. As such, the framework offers a longitudinal insight into the representational and ideological choices of the students. It addresses semiotic activity as a phenomenon of growth and change.

4.6 Processes Charting

Process charting is the first tool to be applied to the tracking of semiosis described above. Having created these longitudinal accounts of individual representational processes it is possible to analyse the occurrences of these processes across both resource texts and students' texts. In so doing it becomes apparent which processes are rejected by the students, which favoured, which reconfigured and so on. It is to account systematically for these changes that the tool of charting representational processes has been devised.

The methodology of charting representational processes is derived from systemic functional linguistics (SFL), in particular, the idea of a system of transitivity which allows for the deconstruction of experience in to phenomena which can be reconstructed through representation into configurations of elements. Such configurations involve processes and participants. These processes and the relations between the participants they embody can be attributed to the text makers' experiences and ideas about the represented phenomena; their interest. Using the system networks of Kress and van Leeuwen (1996), which offer a means for identifying configuration variation with reference to visual representations, this tool serves to chart the representational choices of students in relation to the possibilities

available to them. System networks for the different representational processes are then shown with components highlighted in colour to indicate their presence in the designated text (or group of texts).

The first step in charting representational choice making is to identify the different configurations available for each representational process. For the sake of clarification these are outlined and key terms explained below. Evidence of processes from the texts is then charted – one representational process at a time – on to system networks. This is done in the belief that configuration choices are in close relationship with the (re)construction of knowledge. The purpose of the charting, then, is to provide a view of the shape of students' knowledge making activity by systematically recording their choices concerning the presence or absence of representational processes and their subsequent configuration of those chosen processes. The intention in charting the processes in this way is to render visible the similarities and differences between the configurations of the resource texts and those of the students. There is an important difference between the resource text networks and those of the students' texts. In both the history and the science project there are many resource texts but only one students' presentation text – the artefact texts (see chapter five). Consequently the resource text networks relate to many texts and the students' text networks to just one. As such it needs to be noted that the resource texts networks indicate the occurrence of particular representational processes in any of the various resource texts available to the students. As such they sometimes indicate the presence of more than one configuration at a particular choice junction. Some even indicate the presence of apparently contradictory processes where these occur in two different resource texts. For example in figure 7.2 (on page 196) both agentive and non-agentive configurations of the narrative processes are charted for the resource texts. There is a simple explanation for this. The body of resource texts available to students (as tracked in the grid dealing with narrative representations of filtration in figure 6.1 on page 145) includes both the teacher's demonstration in which the narrative process is agentive and the written extract from the worksheet in which the process is non-agentive. The charting of these two different configurations shows that a choice was made available to students for their own narrative representation of filtration. They could have chosen just one of these two configurations or produced a

combination of the two. In figure 7.1 (on page 194) it can be seen that they chose to use both agentive and non-agentive configurations in their single presentation text.

In contrast to the resource text networks, those relating to the students' texts concern one single text; that of their end of project presentation. In both Science and History, however, these texts are an orchestration of modes and include not only the physical, and visual representations (the science model and the history poster) but also the actions and speech that accompany them. This range of modes is evidenced by the content of the Presentation Text sections of the tracking semiosis grids. The orchestration of modes by students is particularly predominant in the case of their science text where speech, gesture and manipulation of the model work together to more fully represent the process of filtration as they students understand it. As a consequence of this orchestration of modes in a single text, multiple configurations have also been charted in the networks concerning students' texts. The most striking example of this concerns, again, the configuration of the narrative process in the representation of filtration. The students' model configures this process as agentive; their speech as non-agentive. This decision to utilise both the configurations made available to them is precisely the kind of choice-making that the tool of charting representational processes seeks to bring to light.

Because the representational choices at issue here concern the abstract ideological and conceptual part of sign making it has been possible to use the system networks to chart both visual and verbal representations. The system networks of Kress and van Leeuwen (1996), however, concern the visual modes only. Consequently some of the representational configurations they offer are not available in the verbal modes – for example the choice between single and multi-levelled taxonomies in classificational processes. Others configurations, however, such as the agentive and non-agentive narrative processes and the exhaustive and inclusive analytical processes can plausibly be applied to the verbal modes. In this instance, given that the artefact texts are predominantly visual, it has been deemed appropriate to work with a system tailored to the visual rather than the verbal mode and to adapt it as required. Commentaries on the individual charts indicate whether evidence of choice making is taken from a verbal or a visual text or textual element. It should be noted that

underpinning this work is an assumption of the plausibility of a single theory of communication applicable across all modes (Kress, 2003).

Although the system networks here generally conform to those put forward by Kress and van Leeuwen (1996), choice junctions have been added to the narrative and symbolic process networks. An *open* or *closed* choice has been added to the narrative process network and a choice of *direct* or *qualifying* to the symbolic process network. These additions have been made in response to the situated view of the data and relate to representational choices of which evidence has been found. As such they were deemed to be indicators of ideological configurations and thereby to be accounted for.

4.6.1 The Representational Structures

The following system network presents 'the main types of visual representational structure' (Kress and Van Leeuwen, 1996) and provides the conceptual context for the analysis that follows in chapter seven. It can be seen that the principal distinction is between narrative and conceptual processes. Of the students' texts under discussion here, the filtration text is fundamentally a narrative process with embedded classificational and analytical processes. The students' Benin City text, on the other hand, is conceptual rather than narrative in structure with a large number of embedded processes; classificational, analytical and symbolic. What follows is an explanation of how these different representational processes are understood to operate and the different configurations they allow for.

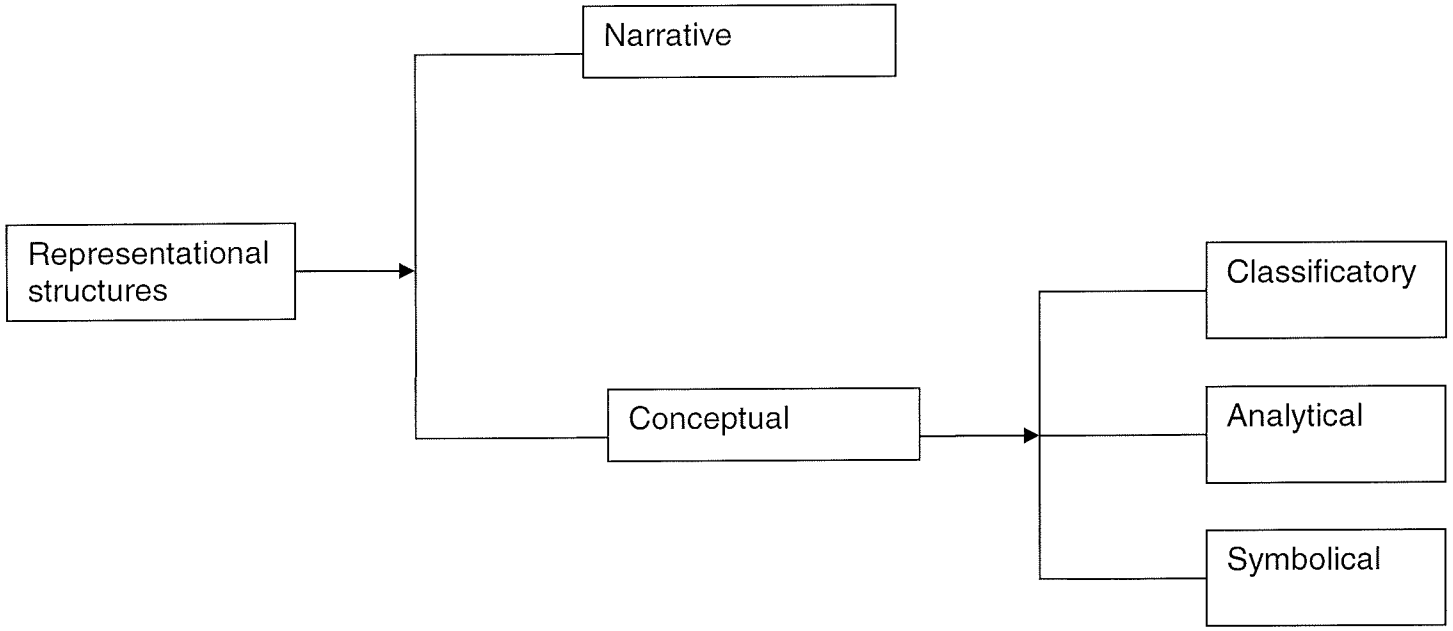

Fig 4.4: The Representational Structures

4.6.2 Narrative Processes

Narrative processes are those that represent an event or happening. As such they represent some sort of change resulting, most commonly, from an action. All representations of filtration are necessarily narrative processes because they seek to show what *happens* when a liquid is filtered. What is at issue is a change, not a permanent state. The main choices facing the producer of a narrative representation involve relations between represented participants – in the case of filtration any of the following could be represented participants; the equipment (filter, flask, funnel), the liquid, the particles. If the representation involves actional modes, the person responsible who carries out these actions is also cast as a participant; they too act or are acted upon. The narrative process configuration, then, concerns how relations between represented participants bring about change. The questions to be asked are: Is there an action? And if so, who or what acts and who or what is acted upon? The narrative is then configured either as an agentive or non-agentive (in which case it is described as a conversion). Where the narrative involves more than one event or happening it is possible for a participant to act as both the goal of one action and the actor of another. This occurs, for example, in the written account of filtration found in the worksheet. The liquid 'mixture' is at first acted upon (by 'you') then itself becomes actor as it 'drips through'. This configuration is described as a relay.

Agentive narrative processes can be either transactional or non-transactional depending on whether the goal of the action is represented or not. In the case of the representations of filtration, the configurations are always transactional because they show the goal of the action; the changed state of the filtered liquid. Transactional processes can then either be shown as unidirectional or bidirectional. Although unlikely, it is conceivable that the event of filtration could be represented as a bidirectional narrative process. A computer generated visual representation, for example, would afford the possibility of showing the filtrate flowing upwards to rejoin the residue and return to the state of being a solution.

A further choice configuration concerning narrative representations that has become apparent from earlier classification and tracking of filtration texts is that of showing the process as either open or closed. This choice – only available where temporal physical and bodily action modes operate – emerged as particularly prominent during

the tracking of semiosis and has been added to the network for this reason. An open process is here understood to be one which is in some way continuous with and connected to external phenomena and objects. A closed process, on the other hand, is contained within a specific physical area and has a definite spatial beginning and end. This configuration involves the text maker in decision making about the relationship of their representation to its immediate physical context. For example the teacher, in demonstrating filtration to the students, chooses to substitute the classroom sink for the beaker in the conventional filtration equipment. In so doing he is said to configure his representation of filtration as an open narrative processes.

4.6.3 Classificational Processes

Classificational processes concern relations between participants in terms of their commonalities and differences. Taxonomies (classifications) represent participants as grouped; similar to others within the group and different to those outside it. Classificational processes are present in both the filtration and the Benin City representations. In the filtration representations it is the particles that are the classifiable participants; in the Benin City representations it is the dwellings.

Represented participants in taxonomy share sufficient characteristics to be classifiable as a generic group. The text producer has a range of representational equivalence markers with which to establish that participants belong to a group. Position, shape, size and colour, being requirements of all visual representations are the most prominent of these. Participants in taxonomy are also different to one another and identifiably separate within the group. For example each of the three groups of ordinary people's dwellings in the students' Benin City plan has a symbolic visual attribute; a pot for the potters' district, a cluster of spears for the spear makers and an elephant herd for the ivory makers. These labels represent both uniformity and difference in the groupings; the label is a feature they have in common but each is unique. Nor is it only visually that equivalence is marked. Uniformity of language structure also features, for example in the captions on the information cards about different trades in Benin City. This uniformity of function across modes enables the configuration of verbal representations to be handled in the charts alongside the visual ones. Similarly the covert taxonomies of the Benin City resource text are found in both the visual representation of the city in the Olfert Dapper book illustration and in

the written captions. This application of the tool to both visual and verbal representations is consistent with the study's aspiration to utilise a single theory for analysis of representations in all modes.

In the charting of classificational processes there are two points at which choices of configuration are made: covert and overt taxonomies and single and multi-levelled taxonomies. The first of these is concerned with the presence or absence of generic or dominant types (superordinates) in the representation of classificatory groups. In an overt taxonomy the superordinate is present and occupies a position in keeping with its overarching, unifying function. In a covert taxonomy the superordinate is inferred from the grouping of equivalent subordinates. It is not present, however, in the representation. A covert taxonomy appears as a collection of phenomena on which the representation confers equivalence. An overt taxonomy appears as a collection of phenomena among which there is equivalence but also dominance of one participant – the superordinate.

The second point of configuration in classificational processes concerns whether the taxonomy is single or multi-levelled. Within a single representation one or more taxonomies may operate. For example the main classificatory group may be shown as comprising of sub groups. This can be seen in the students' representation of Benin City in which the ordinary people's houses which are subordinate to the Palace are themselves sub-divided into the different trades' districts. Where more than one classification process is represented in this way the taxonomy can be described as multi-levelled. Where the representation consists of one classificatory group only it is single levelled.

4.6.4 Analytical Processes

Analytical processes represent a conception of an item. An analytical process has two kinds of represented participants; the carrier (the whole) and the possessive attributes (parts which make up the whole). In the case of the students' analytical representation of Benin City, for example, the plan is the carrier and the separate parts (the palace, forest, prison, districts etc) its possessive attributes. In a structured process the possessive attributes are ordered to make up the whole – in visual representations this ordering is spatial.

Spatial representations furthermore, can be structured as exhaustive or inclusive. Exhaustive structures make the visual proposition that what is shown is the object in its entirety. Inclusive structures do not. There may be visual suggestions that the representation continues beyond what is shown and that there has been selection. The student's rough sketch from the written evidence is an example of this. Roads continue off the edge of the page and there are significant blank areas implying selection. The group's presentation text, however, has boundaries and accounts for every area of space.

Spatially structured analytical processes also necessitate a choice concerning the accuracy of the representation; this may be either topographical (to scale) or topological (logically accurate according to other relational principles). Topographical representations are determined by dimension or quantity. An example of topography can be found in the analytical representation of the particles in the students' filtration model. Here there is a topographical relationship based on quantity; one model particle represents millions of real ones. Topologies are understood here to concern the principles underlying the spatial structuring of analytical representations; the rules governing the positioning of represented participants in relation to one other. These principles are determined by the text makers themselves in order to meet their representational requirements. For example the students, in creating their Benin City plan, are governed by the logics of space and need to choose positions for the different possessive attributes. They decide that accessibility is the most important consideration and it is on this topological principle that the spatial structure of their representation is based.

4.6.5 Symbolic Processes

Symbolic processes, like analytical processes, confer identity on the represented participant. Rather than representing a conception of the carrier as a structured unit consisting of possessive attributes, they endow the carrier with qualities in a more direct way. They represent what the carrier *is* rather than what it *consists of*. Symbolic processes can be either suggestive or attributive. Although both processes embody the same kind of relationship between the carrier and the attribute they operate in very different ways. Symbolic suggestive processes have just one

participant; the carrier itself which is represented in such a way that it is perceived to embody particular qualities. For example the colours red and purple, are widely held in English culture to be associated with royalty. This relationship already being in existence, the quality of royalty is conferred on any represented participant appearing in those colours. In this way, particular combinations of colours, tones or shading styles carry associations with particular cultural or social groups. These references may be conventional, having been established through use by those perceived to be in power over a long period of time.

Attributive symbolic processes have two represented participants; the carrier and the symbolic attribute itself. As with the symbolic suggestive process there is a direct relation between the carrier and the attribute – the attribute represents what the carrier is. This is what is understood by labels – the most easily identifiable symbolic attributes. A label indicates the whole identity of the carrier, not merely what part of it is or what it is like. This being the case, precise identification of the carrier to which the label refers is important hence the use of arrows and stems for example in many of the Benin City resource texts. Because of the precise nature of this relationship the process is inherently unequivocal and necessitates reasoning and rational thought.

Included on the symbolic process network charts is one additional point of configuration; the choice of direct or qualifying in relation to symbolic attributive processes. The differences evidenced by the absence or presence of such embellishments as exclamation marks and bubble frames have been termed direct or qualifying. Direct symbolic attributes are those that are conventionally unequivocal. Qualifying symbolic attributes have been made to appear less conventional and consequently embody some element of qualification.

4.7 Mode Mapping

Mode mapping is the second tool to be applied to the longitudinal view of data afforded by the semiotic tracking. Having addressed the abstract, conceptual configurations of representations through the charting of processes it follows that analysis of the material realisation of this conceptual work should be addressed with equal care. The modes that are addressed by the mapping are the means by which the

invisible concepts are manifest as material representations of meaning; the sounds, shapes, colours and positions that the ideas assume in the form of texts. In the choices of representational modes can be found further evidence of the text makers' interest as shaped by the input of resources; their learning.

The mode mapping tool makes apparent the occurrence of different modes across the transductions and transformations of the two sets of representations; the resource texts and the students' texts. In mapping the patterns of their usage it becomes possible to identify principles of engagement with the different modes. The mapping also identifies instances of transduction (the re-presentation in one mode of something that has been received in another) thus pinpointing where reshaping of knowledge has occurred.

4.7.1 Modes of Representation

Modes are the means by which invisible, mental signs (abstract configurations of processes) become material; they supply the tools for making meaning and provide a physical realisation. Modes, however, are not just the material form in which meanings are realised – they are themselves resources for the shaping of meaning. According to social semiotic theory a mode is a 'culturally and socially fashioned resource for representation and communication.' (Kress, 2003). Conventions are established with particular social groups and in extreme cases something akin to the grammatical and lexical structure of a language develops. In this sense modes are social phenomena; products of the interactions between human beings. Consequently a phenomenon that functions as a mode in one particular place and time does not necessarily do so in another, or may be less developed. In school classrooms, for example, the mode of action is often highly conventionalised and regulated as a carrier of meaning. A particular teacher's physical gestures and movements are likely to be understood quite precisely by her or his students. In other social environments the same mode (action) may be absent or less prominent with little or no shared understanding of conventionalised references.

Given that modes are shaped by social context it is important to specify, prior to the mapping itself (chapter eight), which phenomena are to be considered as modes. The following have been identified as modes because their usage, in the two classroom

contexts, is systematic and conventionalised indicating the existence of a set of shared meaning references among the social groups concerned i.e. the students and teachers. These modes, then, are the principal means of realising, in material form, the inner (conceptual) signs of text makers at both these sites. It is to the use of these modes that the mapping will be applied: speech, writing, visual-spatial, visual-shape, colour, texture and action.

The mode mapping (chapter eight) is preceded by a detailed account of the occurrence of each mode at the respective sites. Mapping then consists of an overview of the patterns observable in the relationship between choice of representational configurations and mode. Having thus described the operation of mode on the representational processes, key instances of transduction emerge and are analysed. Lastly from the perspectives afforded by the mapping, there is an exploration of the impact of modal engagement on knowledge-making.

Chapter Five
Establishing a Record

5.1 Introduction

This chapter provides a detailed examination of two student produced texts from the findspots identified in chapter three – a model of filtration and a plan of the ancient city of Benin. It is around these artefact texts that the research as excavation will proceed. The reasons for focusing, in a concentrated way, on these two particular texts will first be set out. Then, in the spirit of an archaeological excavation the artefact texts will be described in detail and classified according to the preferred typology. The choice of classification tools (the theory) and an explanation of how they are to be employed (the methodology) have been presented in chapters two and three.

5.1.1 The Semiotic Environment

Extracting one particular text from a web of semiotic activity and subjecting it, in isolation, to classification and analysis as a finished piece seems at odds with the theoretical position of this study. Although punctuated through the material realisation of signs as individual texts, semiotic activity, it has been suggested, is inherently ceaseless – not something that can ever be finished. It includes both physical, material sign making and conceptual, invisible sign making. Having said this, analysis requires the anchorage of semiosis in fixed, material texts. To see what is going on, the complex, ongoing work of semiosis needs to be viewed from clearly identified standpoints. Only by lifting a text from the semioitic web can its origins and shapings start to be traced. These two principal texts have thus been removed from their original contexts to the semiotic environment of this study where they will serve as fixed, stable representations to which other semiotic activity and resultant texts can be related.

The selection of these particular texts was guided by some conventions of the prevailing school culture, in particular the practice of presenting work to the rest of the class. In both the Science and History units students were required to finish pieces of work and present them to the rest of the class during specific lessons. It was

decided, then, to take, as principal texts, the ones which had been presented (shown and talked about by their makers) to the rest of the class. In addition, these were the texts which could, most easily, be isolated and removed as artefacts from the sites.

As much of the following chapter deals with the two principal texts in isolation it is valuable, at this stage, to strengthen the underlying principle that they are, as products of semiosis, part of a broad continuum of representational work. In spite of the institutional requirements to finish their pieces of work, student talk during and after the time allocated for doing the representational work clearly shows that sign making continued after the work was supposed to have been completed, through and beyond the presentations. The following extract from an interview conducted the day following the presentation of the filtration model shows the extent to which the students continued their semiotic work of representing the process of filtration.

> ***A*** *We had a little bit of problems with that. Because we were like planning to mix the red and the blue particles together, pour it in, and just make the blue particles go through but we knew that* (pauses) *that was going to be impossible. So we just had to pick them out again.*
> ***D*** *We had to work our way round it in showing it while doing the presentation.*
> ***A*** *So obviously we had to take the filter paper out and put it in by hand.*

Language and gesture had indeed been used during the presentation in conjunction with the model itself to create new signs. It was also apparent from the pauses and thoughtful handling of their model during the interview that the students were continuing their work of representing the process of filtration as they thought and spoke about it.

In science the students complemented and added to what was signified by their model with gestures and language. In history they continued the semiotic work in more dramatic ways by imaginatively revising and modifying their plan of Benin City even though the conclusion of the unit of work meant that the plan could not be materially changed. The following comments were made by students during the post project interview.

D *Yeah, and these are the nine gates (*starts to count them with finger*). We did draw it all in black pen and so we had to tippex some of it afterwards.*

A *But afterwards we realised they were supposed to be all over the city.*

Having thus demonstrated that the two artefact texts are indeed part of a broad continuum of semiotic work, these texts nevertheless render themselves suitable for classification and analysis in that they were given 'finished' status by their production contexts. They are also materially complete - it having been possible to physically remove them from their production environments. The first text, the filtration model bears some marks of completeness – all the component parts necessary for filtration to take place are present and can be arranged to show which ever stage of the process is required. As an object it can be moved around and does not rely on its physical environment to carry its meaning. Moreover it was labelled with a title and the names of its makers. It was also presented to other students and the teacher as a completed object representing the students' best attempt at communicating the filtration process at a given point in time with the resources that were available. Likewise the plan of Benin City incorporates all the elements that the students deemed important at a given point in time with the resources that were then available. It too is a movable, finite artefact.

5.1.2 Retrieval of the Artefact Texts

While the sites chosen for this study (secondary school classrooms) host a vast array of texts - all of which are instrumental to making and maintaining knowledge - it is to the artefacts texts made by the *students* that this research is ultimately directed. There is one main reason for this. It is the *student* produced texts that provide most evidence of the kind of knowledge making that can most aptly be described as learning. The focus, then, is on what students make of all the other texts that are around them – the available resources. These texts include the conventions and practices of the school and the subject being taught as well as the specific text books, worksheets and input from the teacher (see chapter three). What the students made materially as a result of this input is an indicator of what they made conceptually. The task, then, is to look for indicators in the student produced textual material of what they were thinking – what they considered important and what not, how they

connected parts of the knowledge to each other and what qualities and attributes they deemed to be essential or criterial. This being the main thrust of the research, investigation of other texts at the site (text books, classroom displays and texts produced by the teacher) is engaged with only in so far as it informs understanding of the *students'* text-making. Teaching texts are not offered here for analysis in their own right but as resources with which students work to produce their own texts.

There are not only theoretical reasons for selecting student produced texts as the primary focus. This is also an ideological stance arising from a concern – in wanting to understand more about teaching and learning - to turn the concentration of interest from activities of institutions and their agents towards those of the students themselves. In this paradigm the insubstantial and frequently discarded student produced texts – scribbled notes and sketches, fading sugar paper posters and fragile models - are central to learning, not incidental by-products.

Here, the sites from which the two key texts were retrieved exemplify how regular disposal of student produced texts is necessary to enable schools to function effectively. After a delay in collecting the students' work at the end of the science project, the model, which had been put aside with care, was retrieved with the rest of the classwork from the back of the science laboratory. Once the whole class presentations were over the students' texts were not looked at or moved for several weeks – some were water stained, some crumpled and folded – parts were scattered and needed to be reassembled. Under normal circumstances they would have been thrown away, for the class had moved on to new topics and needed a clean, safe and clutter free environment to work in. Meanwhile in History, the Benin City poster which has been retrieved was one of dozens neatly piled on the floor of a walk-in store cupboard (their size and a desire to store them flat making storage a problem). Only a small number of the numerous posters were to be used for displays.

Significantly the teachers themselves expressed considerable appreciation of their students' work. The Benin City plans were carefully stored and teachers took pleasure in sorting through, looking at and discussing what had been produced expressing a wide range of responses – fascination, amusement, confusion, intrigue and delight. Storage, however, needed to be justified given the quantity of student texts being

produced on a daily basis and space was limited. In spite of their best efforts, much student work quickly deteriorated. Once it had been evaluated against the relevant teaching objectives it was necessary to move on to new topics. Opportunities for appreciation and analysis had passed. Nevertheless the teachers expressed a strong sense of the value of their students' work as products of learning. There was a powerful, yet inexplicable feeling that the students' work itself can make sense of the mysterious relationship between teaching and learning.

5.2 Principal Artefact Texts

The following exercises in description and classification are carried out for the purposes outlined above - to facilitate understanding of the artefact texts as representations of phenomena so that beliefs about that world (whether experienced directly or through other texts) can be uncovered. In terms of social semiotic communication theory this amounts to an exploration of the ideational metafunctions of the texts. As such, this classification deals with particular categories of textual attributes only and does not claim to do even this exhaustively. The scope and extent of the classification is intended to meet the theoretical requirements of the research.

Two principal texts (below) have been chosen for the reasons outlined above. To reiterate, as observable, finite, permanent artefacts they will serve to anchor the intangible, often invisible semiotic activity of the students. It is to inform understanding of these principal texts that all analysis of the fuller range of semioitic activity takes place.

5.3 Filtration Model: A Narrative Representation

Figure 5.1 is a model of the process of separation by filtration. It is 28 centimetres high, lightweight and makes use of clear plastic, coloured paper, cotton wool and a mass produced sticky label with an inscription in coloured felt tip pen.

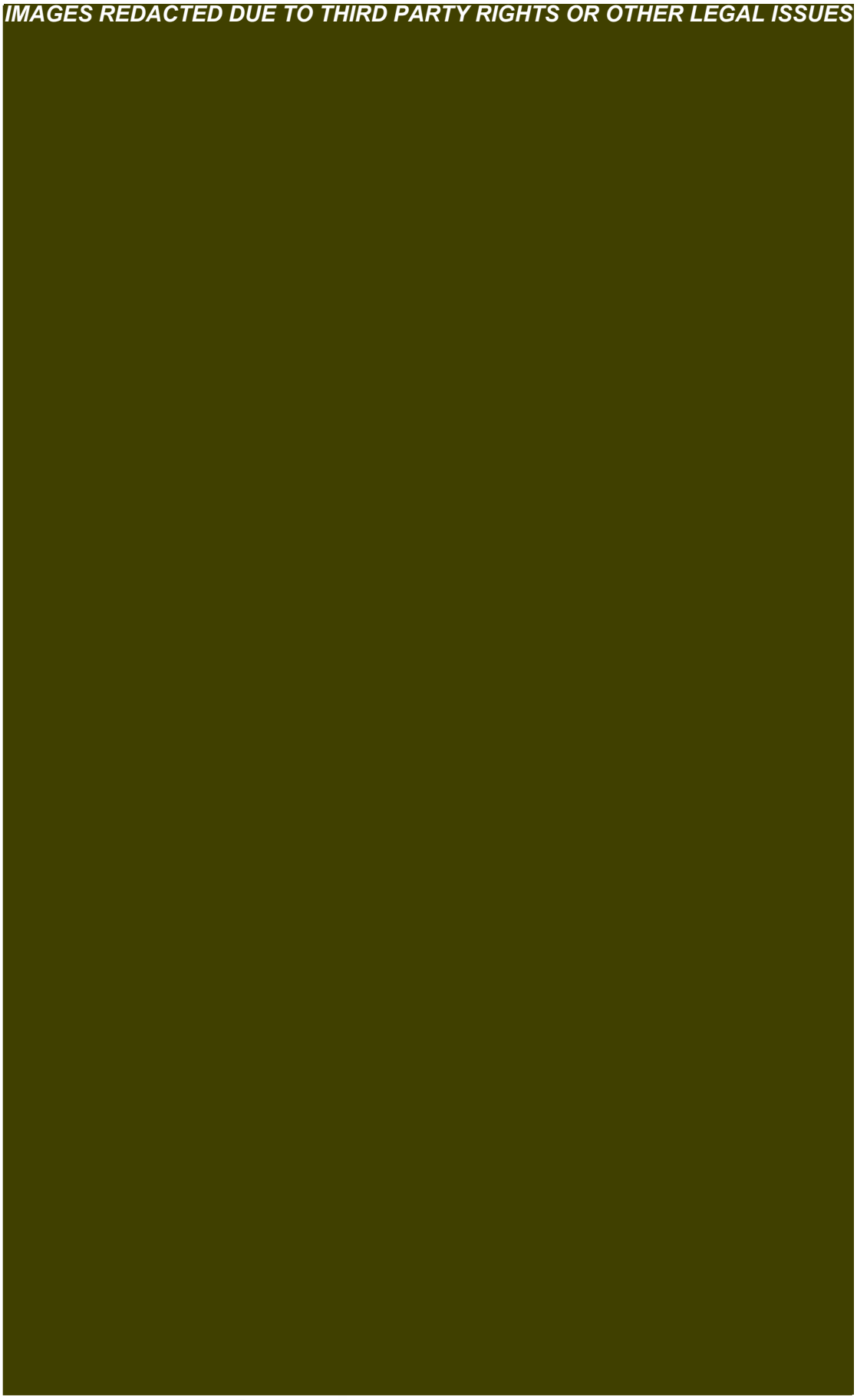

Fig 5.1 Principal Artefact Text: Filtration Model

By looking at this artefact text with the chosen typology in mind it is possible to identify the different representational processes at work (see 4.6). On the basis of this, the model can be classified as a narrative representation of a process embedded within which are a number of conceptual representations including a classificational process and an analytical process with dimensional topography. As a unit of communication its structure is not unlike that of a compound sentence. The following sentence is an approximation of the model's meaning expressed in verbal mode:

> *The equipment, which is specially shaped, transparent and put together in a particular way, separates the mixture of particles which are round and unevenly shaped, tiny and extremely numerous and can be divided in to two groups.*

The main clause: '*The equipment separates the mixture of particles...*' conveys the narrative element of meaning. Two subordinate clauses add detail: '*which is specially shaped, transparent and put together in a particular way*' (of the equipment) and '*which are round and unevenly shaped*' (of the particles) do the work of analytical processes. '*Tiny and extremely numerous*' deals with dimension and quantity and '*can be divided into two groups*' the classification of the particles. This rather crude transduction from the three dimensional visual mode to the verbal serves to show that while meaning potentials of the two modes differ greatly, there is no reason why the model, as a unit of representation, can not also – like the grammatical structure of a sentence, be described and classified.

The model is first and foremost a representation of an event – filtration. Its primary function is to show how filtration *happens.* Because it deals with a happening or event, the representation can be classified as a narrative representation and as such shares characteristics with other representations that communicate causal, sequential phenomena. Description of narrative processes is done in the verbal (speaking and writing) modes using well established grammatical terms to refer to the linguistic forms that do the job of communicating events or happenings. For example there is the term *transitive verb.* The presence of this feature in a spoken or written text means that something or someone carries out an action on or to another. With

reference to visual representations the term *represented participants* is used to refer to the items which either act or are acted upon.

5.3.1 The Narrative Process

In a functional semiotic classification of this model two represented participants can be identified: the liquid mixture and the equipment. The liquid mixture is represented as two groups of inter-relating particles (red and blue coloured balls) and the equipment as the assemblage of filter, funnel and flask. The visual proposition of the model is one of action. The equipment forms a vector pointing downwards through which the mixture is passed and worked on. Clearly then, there is a transaction; one participant acted upon by another. The visual proposition of the model is that the equipment itself is the actor; no other agent is represented. The combined group of particles (the mixture) is the goal and the occurrence of filtration the transaction.

In this model relations between the represented participants are realised in particular ways. Firstly the direction of the transaction is unidirectional from top to bottom. The process starts from above and, following the pull of gravity, ends at the base of the flask. There is no provision in the model for the process to be reversed, only to be repeated. The shape of the model is elongated vertically rather than horizontally. In addition, the shape of the filter and funnel make a visual 'point' or vector in a downwards direction. This is realised both by the shape of the model filter cone and the model funnel. The straight sided section of the plastic bottle used to represent the funnel has been completely removed – only the tapered, pointed part has been used. Secondly the 'goal' participants (the particles) are contained *within* the actor – the transaction is internalised and enclosed. Having entered the equipment part of the model from the top, there is no exit point for the model particles – they can not just flow away. Thirdly the relation consists of three clearly observable parts or stages – the filter cone at the top, the point of filtration immediately below this and the flask at the bottom. In the first two stages the 'actor' particles are invisible. In the final stage they are visible. The first two stages are open – they can be added to, or changed and as such are unpredictable. The final stage is enclosed, finished and complete. Finally the importance of the second stage of the transaction is amplified by the presence of the white label stuck around it bearing the title 'filteration' in capital letters. This label conceals and mystifies the actual point of filtration.

5.3.2 Classificational Processes

On further observation it can be seen that a number of conceptual processes are embedded in the narrative representation. These conceptual processes differ from the narrative in that they are concerned with what is stable and unchanging.

Firstly there is a classificational process that can be observed. There are two groups of particles present in the model – a group which represents particles acting as a solid and a group which represents particles acting as a liquid. A covert taxonomy is at work here through the inferred equivalence of the two groups of particles. Equivalence between these two groups is shown in a number of ways; the two groups of particles are similar in quantity and the size and shape of the particles differ only in one defining respect - colour. The taxonomy is said to be covert rather than overt because the superordinate (a generic particle) is absent from the representation. The existence of a superordinate, generic particle is implied by the representational process itself as is the possibility of other subordinates for example, particles acting as a gas.

5.3.3 Analytical Processes

Representation of the filtration equipment (flask, funnel and filter paper) is a spatially structured analytical process in which the constituent parts fit together to make up a whole. The positions of the different parts in relation to each other are instrumental in representing what they are – they have been assembled. For example, the success of the inverted plastic bottle top in representing the funnel is dependent on its position in relation to the other pieces of the model. The scale of the items is slightly larger than life with the flask excessively elongated. Three quarters of the height of the model is taken up by the flask. In addition, certain possessive attributes of the equipment pieces have been selected for representation over and above others – transparency and shape being the most important.

In the analytical representation of particles two particular essential characteristics (possessive attributes) dominate: they are round and unevenly shaped. The appearance and texture of the model particles was achieved by taking pinches of cotton wool, dipping them in coloured paint and leaving them to dry. This production

process chosen by the students was inherently variable unlike the cutting of regular circles from a template – an idea they rejected. As a result of this, each particle is visibly unique in shape.

5.3.4 Topographical Processes

Finally, dimensional and quantitative topographies can also be observed in the representation of the particles. Clearly the size of the particles has been greatly enlarged in the model. Students have neither attempted to show the particles in great quantity nor as excessively small. Each particle in the model has been magnified an unspecifiably large number of times. Regarding the quantitative topography there are two possible readings of the representation. There are just sixteen particles of each type. This small number of particles can be taken as a representative few (a tiny proportion of the actual number of particles) in which case the relationship is that of one real particle to one represented particle. Alternatively the small number of represented particles can be read as representing, in a much looser relationship, the *whole* body of particles in which case the quantitative relationship is that of an unspecified multitude of real particles to one represented particle. Both readings of the representation, however, reveal that the dimensional and quantitative topographies were informed by the need to make filtration visible to the naked eye.

5.4 Benin City Plan: A Conceptual Representation

Figure 5.2 is a plan of the ancient city of Benin. It consists of a flat poster size sugar paper sheet (84 cm by 59 cm) with inscriptions and blocks of colour created using coloured felt tip, crayon, pencil and ball point pen.

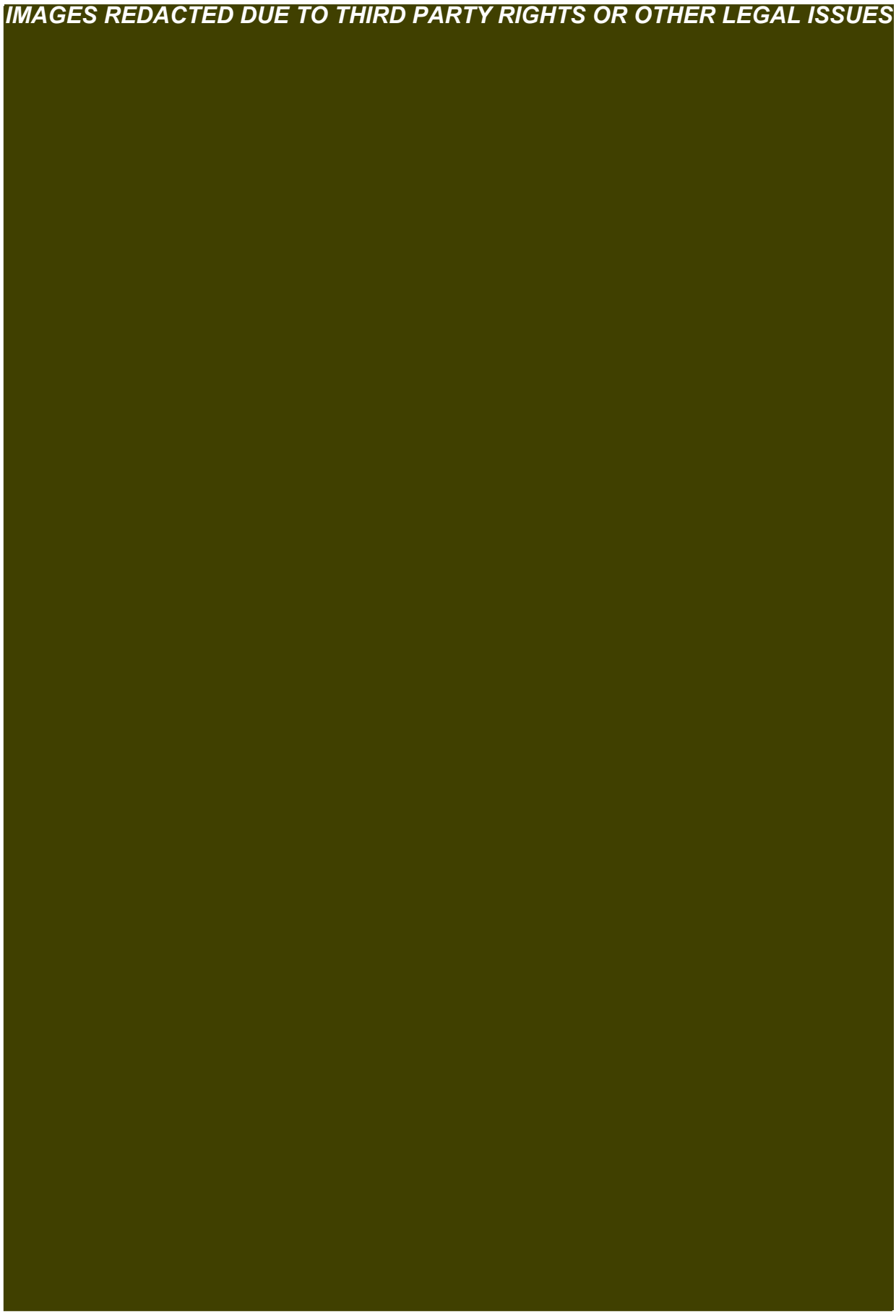

Fig 5.2 Principal Artefact Text: Benin City Plan

This two-dimensional visual text has a more detailed structure than the filtration model. The Benin City plan shows the physical characteristics of the ancient African city at a given point in history – the height of Benin civilization during the rule of Ewuare the great c.1440. Unlike the filtration model, it does not concern an event or a happening. This representation deals with *what* is there, not how it came about. Such representations, according to our typology, are said to be conceptual - presenting something in terms of its essential characteristics and structure without reference to origin or change. On close examination it can be seen that the Benin City plan is a conceptual representation embedded within which are further classificational, analytical, topological and symbolic processes.

Given the absence of a transaction (event or happening), an equivalent verbal representation would consist of sentences with long strings of embedded detail of increasing levels of specificity. In the verbal modes prepositional phrases and subordinate clauses would serve to link and order the relevant parts. For example: *The city has a royal palace which is large with courtyards and gates with special powers which protect it from evil.* Or *The City consists of a King's palace and three districts where ordinary people live: an ivory district that has rows of regularly shaped, small, mud and straw houses and is close to an elephant enclosure with access to the rest of the city, a pottery makers district...etc.* Although these verbal transductions of the meaning represented by the Benin City plan are helpful in maintaining an appreciation of the overall shape and complex structure, they cover only a tiny proportion of what is represented visually. Were an attempt made to more fully transduct what is visually represented, the exercise would quickly become too lengthy and awkward to pursue. In short, the complexities of meanings represented by the various processes outlined below *belong* in the visual. Here the affordances of the mode not only accommodate but require the representation of certain kinds of meaning which can not be adequately communicated in words.

5.4.1 Classificational Processes

An immediately observable feature of the Benin City plan is the way in which it spatially groups and organises the represented participants on the poster sheet. This is a classificational process in which participants are shown to belong to groups with which they share certain attributes or could be said to be equivalent. The relating

of participants in this way serves to highlight relationships of similarity as well as of difference. These groupings are known as taxonomies and their representation lends itself to visual rather than verbal modes. In the visual modes the logics of space apply and represented participants are prone to grouping. Unlike the covert taxonomy of the particles described in the filtration model, the taxonomy observable in the Benin plan has a clearly visible superordinate. The participants in this taxonomy are all dwellings (including the palace) and share a geometric, rectangular shape. The superordinate is the Oba's palace and the subordinates the ordinary people's dwellings which are not only geometric and rectangular in shape but also share a star type roof pattern and brown pencil shading. They are arranged in groups. The visual equivalence is not quite complete, however, for the Ivory district, on the left of the plan occupies double the space of the other two districts. As such it is superordinate in a second, horizontally oriented taxonomy of trades and crafts in which the Pottery Makers and Spear Makers are subordinate participants. As such the image can be classified as a multi-levelled overt taxonomy. The dominant classificational image structure however, is the vertically oriented taxonomy of dwellings with the Oba's palace positioned at the top and the ordinary people's houses at the bottom.

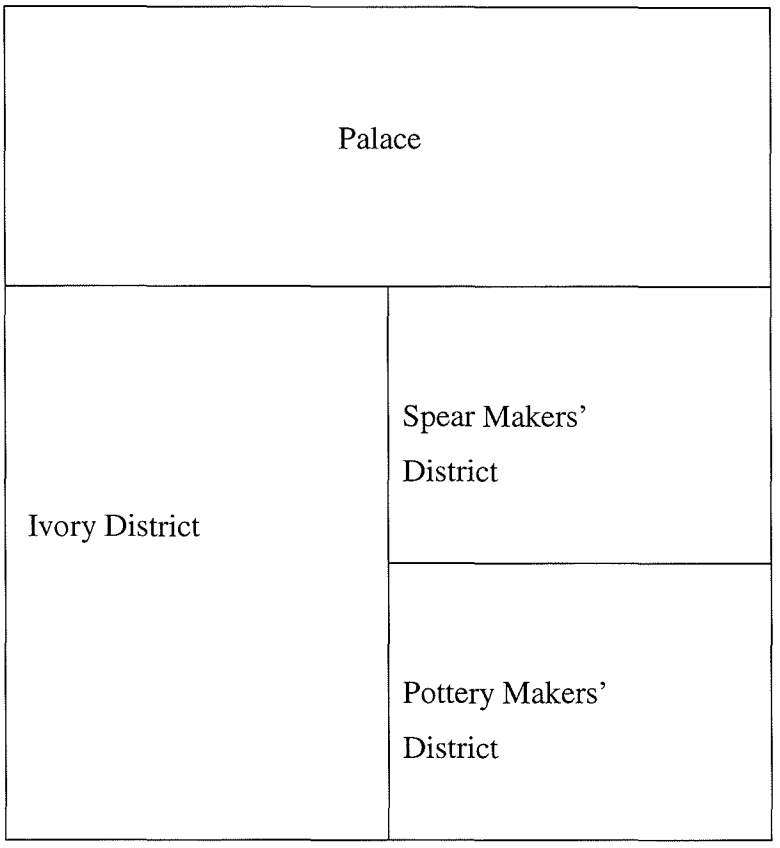

Fig 5.3 Benin City Plan: multi-levelled overt taxonomy with vertical and horizontal orientation

5.4.2 Analytical Processes

The principal representational process of the Benin City plan is an analytical process in which parts are structured to make up a whole. In this process the parts of the city are possessive attributes of the carrier (the city as a whole). The Benin City plan uses the space on the poster paper to show the position of the possessive attributes in relation to each other in a meaningful way. As such it is spatially structured. The overarching analytical process will be accounted for here in some detail.

The possessive attributes of the carrier (the city) in this process can easily be identified: the palace, the prison cells, the gateways, the roads, the forest, the dwellings, the water, the ditches and the elephant herd. The presence of these possessive attributes, rather than others, is the result of selection by the students. These are the characteristics or features that have been singled out from others and considered appropriate for the representation of Benin City. By implication, other

characteristics of which the students were aware have been discarded. It is typical of analytical processes that there is lowered modality. The Benin City plan is a good example of this; there are labels, there is little detail, background is not filled in, there is no perspective or depth and colour is used to distinguish participants rather than to resemble reality. There is one other important feature that marks out the representation as being analytical rather than life- like: the complete absence of inhabitants – there are no people depicted. Interestingly, this lowered modality serves to emphasize the *spatial* organisation of the possessive attributes. In this way the analytical and classificational processes (described above) complement one another.

There are several embedded analytical processes in which the possessive attributes of the city as a whole become carriers in their own right. For example, the palace (a possessive attribute of the city) is also a carrier with its own possessive attributes. Here the modality is significantly lowered – there is a notable absence of detail and the use of bright purple and red colours are entirely symbolic, not naturalistic. The selected characteristics here are limited and very specific: the qualities of being royal and protected from evil, largeness, and the presence of courtyards and surrounding walls. Of the embedded analytical processes (in which the possessive attributes become carriers in their own right), only one – the Oba's palace - has been selected to demonstrate analysis of how processes operate at this level. The tools of tracking semioisis, process charting and mode mapping will only be applied to this particular embedded analytical process (see fig 6.9).

5.4.3 Inclusive and Exhaustive Processes

One of the most important considerations when classifying spatially structured analytical processes is the extent to which the representation is structured as if it is showing the whole of something or just a part of it. If all the space is taken up and the carrier appears to be fully accounted for in what is represented, then it is *exhaustive*. By contrast, *inclusive* representations leave blanks – only certain parts of the carrier are selected - others are not accounted for. In an exhaustive representation, the separate parts are assembled to make a whole.

The Benin City plan has no blank spaces – gaps between the possessive attributes have been coloured in yellow. As such these yellow areas become possessive attributes in their own right - a feature of the city i.e. areas of uncultivated, unoccupied land. As an exhaustive structure the plan divides the *whole* of the city into possessive attributes. This being the case, its assembly – the relative positions and sizes of the parts – is important. It is as part of this exhaustive process that the classificational and topological processes are realised.

Within the structure of the Benin City plan, however, there is also an inclusive process at work. Contradictory though it may seem, both kinds of process (exhaustive and inclusive) are realised within the same representation. There is no doubt, as shown above, that there is an exhaustive process is at work – spatially the plan is seen to account for the city in its entirety. In terms of its *constituent parts*, however, this is not the case. As a birds eye view the plan of the city is being offered as a map. The reading of maps is well established culturally and socially. It is a given of any map or bird's eye representation of a geographical area that it includes *only* the features deemed to be relevant and or interesting in the given context. As a type of map, the Benin plan does not claim to represent everything in the city. As such there is nothing in its appearance – its visual proposition - that claims that it is representing *every* feature of the landscape. Only those of interest and relevance have been selected. It needs to be acknowledged then, that both inclusive and exhaustive processes are realised within the same text - each realisation resulting from a different series of text maker choices.

5.4.4 Topological and Topographical Processes

In the process of classifying the Benin City plan it is also necessary to account for the sizes and spaces between the represented participants for they are clearly not to scale. Were it to scale, the Benin City plan would accurately represent the actual physical sizes and spaces and as such could be classified as a topographical process. This is not the case. Topological processes, on the other hand, employ their own logics governed by the requirements of the context. This does not make topological processes intrinsically less accurate or reliable – merely different in the way they operate. What is at issue, then, are the principles on which the relative sizes and spaces of the Benin City plan are based – its topology.

There appears, in the plan, to be one principal logic on which the spacing of represented participants is based: that of access. What is important about the roads and gates is that they are positioned to allow access to different parts of the city. Where the roads lead to is what determines their position in relation to other represented participants. Secondly key resources (water, ivory, and wood) are positioned in close proximity to the districts which require them. The elephant herd enclosure is positioned (regardless of any other guiding logics) close to the ivory district. The forest, being an important resource for all ordinary people, (for firewood, food etc) is equally accessible to all districts, running, as it does along both sides of the lower two thirds of the plan where the dwellings are located. Likewise there is a water supply for each of the three districts – the river at the edge of the forest for the spear makers and pottery makers on the right and the lake for the ivory makers on the left. It is the proximity of these represented participants in relation to their users that is the determining logic in their positioning.

The configuration of size also has its own guiding principles – represented participants are not to scale or naturalistic. The roads in particular are excessively large. The City Road alone covers an area equivalent to that of the pottery makers and spear makers district put together. The Oba's palace, meanwhile, occupies the largest area of the plan. It is at the top and takes up a third of the space. These configurations of size are determined by perceptions of importance. These participants are also given the most salient positions in the composition - the City Road is central and the Palace at the top.

A further topographical issue concerns the ordinary people's dwellings. In the three districts each represented house is large enough to be clearly visible as a separate unit. The number of houses represented, however, is very small. The pottery makers' district has just four. This being the case, it can be seen that there is a representational principle at work which can be summarised as *one represents many*.

5.4.5 Symbolic Processes

Two of the most striking features of the Benin City plan have yet to be accounted for by the processes described above. Firstly there is the use of colour and its blending –

felt tip pens and crayons. Secondly there is the presence of labels – images and words in bubbles attached to stems that link to specific represented participants. Both these features can be accounted for by classifying them as symbolic processes.

Symbolic processes establish what a participant is or means. They can be either attributive – conferring identity on a carrier through an externalised symbolic attribute or suggestive, establishing the identity of the carrier through the mood or atmosphere of the representation of the carrier itself. In the case of the Benin plan the use of colour and its blending is a suggestive symbolic process and the use of labels is an attributive symbolic process.

The suggestive symbolic process in the Benin plan establishes the generalised essence of different represented participants in the way that they are coloured. The forest is a blur of details with overlapping colours and random shapes. The materials used are both felt tip and crayon. The colours are naturalistic green and brown and mostly crayon – more natural than felt tip. The generalised essence of *forest*, then, is natural, organic and disorderly. In contrast to this, the Oba's palace makes use of strong, vivid colours. The colouring material is synthetic felt tip. Boundaries are clearly visible and there is no overlapping or merging of colour. The suggestion offered by this symbolic process is that there is order and control as a result of human activity – the antithesis of the forest. The suggestive symbolic process embedded in the representation of the ordinary people's houses (the districts) conveys neither the man-made orderliness of the palace nor the natural chaos of the forest. Colours used here are naturalistic – different crayon shades of brown, but the boundaries are clearly marked and there is none of the merging and overlapping texture of the forest. There is an element of man-made order but not complete control over nature.

The attributive symbolic processes in the Benin City plan are systematic and consistent with one another. Symbolic attributes are made salient in the following way. They are located inside black felt tip bubbles and are linked to the carriers to which they refer by means of a pointer – a thick black felt tip line with a large dot located inside the carrier itself. This pattern is consistent whether the symbolic attribute is represented visually or verbally. Several of these symbolic attributive processes offer different views of (and therefore more information about) the ordinary

people's houses. There is an opened up view of a house in each district in which the roof is removed showing the arrangement of rooms and furniture. In the ivory district there is also a side view.

In the spear makers' district the visual symbolic attribute of the opened up house has its own verbal symbolic attribute. The two different symbolic attributes can be identified by the position of their pointers. The pointer of the verbal symbolic attribute ends in its carrier; the opened up view of the ordinary person's house which is itself a symbolic (visual) attribute of the bird's eye view (fig 5.4):

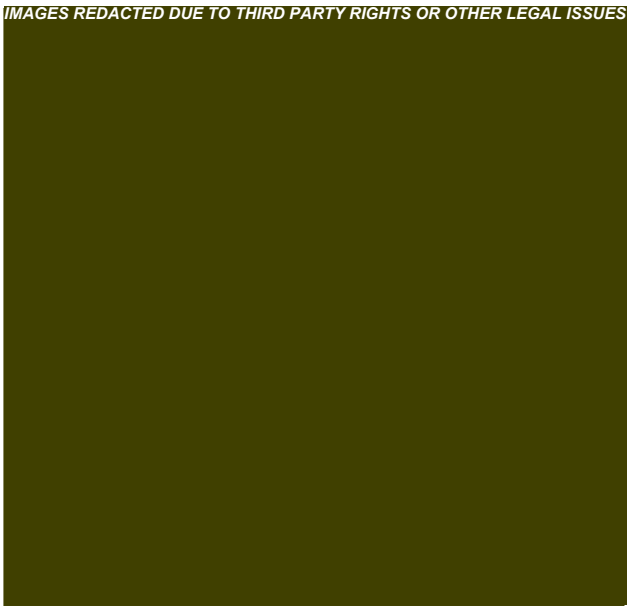

Fig 5.4 Visual and Verbal Symbolic Attributes of Houses in the Spear Makers' District

The second set of symbolic attributive processes utilizes conventional associations to do with the trades of the districts. Using the same bubble and pointer described above there is a clay pot symbol for the pottery makers' district and a cluster of three spears for the spear makers district. Both of these visuals have iconic status – they are decontextualised – neither to scale nor consistent with the bird eye view of the plan. Their meaning operates in a different way to that of the other representations around them. Their purpose is to symbolise the respective trades.

Although there is a good deal of consistency regarding the symbolic processes embedded in the Benin City plan representation it is worth noting a deviation. Interestingly there is no symbol for the ivory district equivalent to the clay pot and spears. Also the open roof view symbolic attribute in the ivory district is not visually linked to a carrier house as are those in the other two districts. It has no felt tip border and no pointer. These characteristics, along with other differences and inconsistencies noted elsewhere, contribute to the sense of difference about the ivory district.

The second noteworthy inconsistency among the symbolic processes is the absence of a related participant for the prominent symbolic attribute in the upper centre of the Benin City plan – the cross. As a highly conventionalised Christian religious image it symbolizes protection from evil. It is not, however, related to a particular participant or participants - it has no frame of any kind and no pointer but is positioned at the end of the City Road in front of the entrance to the Oba's palace. Discussion of the significance of these and other variations will be returned to in Part Three.

There is one final feature of the symbolic process which needs to be accounted for – variations in the verbal symbolic attributes (written labels). These are either single words (or phrases) or short pieces of text and are written either in ball point or thick felt tip pen. They also have a variety of frames: circular, bubbly or no frame at all. As these features are prominent and no doubt meaningful in their own right, it is necessary to include them in the classification. On this occasion, however, there is no suitable typology within the existing system to classify features at this level (characteristics of symbolic attributes). The following categories, then, are offered for this purpose: *direct* and *qualifying*. Direct symbolic attributes are offered as verbal equivalents of visually represented participants with an assumption of *direct* correlation. They are not framed but are written straight onto the represented participant to which they refer. Characteristically they are in capital letters. The labels for the City Road and the forest come in to this category (see fig 5.5).

Fig 5.5 Forest Label – a Direct Symbolic Attribute

The second group of verbal symbolic attributes will be referred to as *qualifying*. These offer assertions about the participants to which they refer that are contentious but to which a strong commitment is being made. Their identifying feature is their frame. The labels for the elephant herd and the house without a door both come into this category (see fig 5.6).

Fig 5.6 House Without a Door – a Qualifying Symbolic Attribute

Other qualifying verbal symbolic attributes are represented with even higher levels of uncertainty. These can be identified by their embellishments; a bubbly frame or an

exclamation mark. The labels for the Oba's palace (King's court) and the gateways come into this category (see fig 5.7).

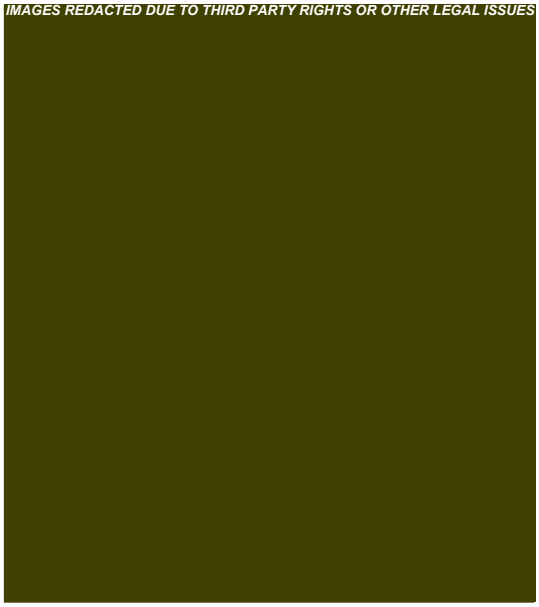

Fig 5.7 Gateways Label – a Qualifying Symbolic Attribute

Chapter Six

Tracking Semiosis: A Longitudinal View

6.1 Introduction

In the previous chapter the principal artefact texts were described and classified. It is now necessary to re-establish their connections with other related texts in order to reveal how they came in to being. The tracking approach used here – the positioning of selected texts in an ordered sequence – has been described in chapter four. As a methodological approach it bears comparison with the stratigraphing technique used in archaeology. Both are concerned with ordering a vast expanse of seamless phenomena into workable blocks. Both are concerned with evidence afforded by the wider context and require systematic organisation. In this case the sequence in which artefact texts are arranged has been designed to track the semioitic activity from which the final texts were brought into being. As such it shows, in a sequence format which is largely chronological, the input resource texts, the transitional texts produced during the text production process and the final artefact texts.

6.2 Representations of Filtration

Five tracking semiosis grids will be presented here in relation to the representation of filtration in science. Each grid concerns a different representational process and will be followed by detailed commentary and analysis.

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6.2.1 Narrative Processes

Figure 6.1 tracks representations of filtration as a narrative process. In the first column are three representations that were made available to students. In the second column are two types of transcribed student talk: fragments of dialogue taken from sound recordings of students at work and extracts from an informal interview. Although recorded at a later date, the extracts from the interview are included here because they refer to and account for decisions made at the design stage. In the final column are photographic images and transcribed sound recordings from the students' presentation of their filtration model to the rest of the class. All texts included here are concerned with representing how filtration happens – the action process.

The resource texts in the first column offer particular ideational configurations of the process with different interpersonal arrangements The first of these is the fragment of teacher talk in which a range of features need to be viewed as available resources. The most striking of these concerns not the ideational configuration of knowledge but the interpersonal relationship within which the teacher's representation of filtration occurs. The teacher establishes common ground with the students by the repeated use of 'we'. Addressing the students as equals in this way makes available to them a sense of themselves as novice scientists being initiated in to the conventions and practices with which the teacher is fully qualified and conversant. In keeping with this, the teacher's spoken input explicitly focuses on the actions of scientists in relation to the specific task – the need to 'recognise (the process)', 'use appropriate words', 'describe using a model', and 'try to make things more understandable'. These are offered as the higher order scientific activities in which the students are to be engaged while carrying out the lower order task of representing a separation process (filtration).

Secondly the teacher, in his demonstration, makes available the experience of observing filtration actually happening. Although this is presented as a direct experience of a real life phenomenon it is nevertheless arranged and organised according to particular ideational criteria. As such it needs to be included as a resource text; this time realised through the modes of action and speech. Most significant, here, is the relationship between represented participants. The teacher himself is the actor in the action process. The mixture, referred to as 'this', is the goal

and the occurrence of filtration the transaction itself. In his speech the teacher attributes the action to himself 'Now I'm filtering ...'. Reinforcing his role in the transaction are the teacher's actions – his bodily position and movements in relation to the filter paper and its contents. Rather than using the conventional equipment (flask and funnel) the teacher uses his own hand to support the filter paper. Without the funnel and flask to act as containers the whole process is opened up and made as visible as possible. Instead of being carried out in the conventional science equipment, the filtering is done over the sink (reinforced by teacher's words) – a location synonymous with everyday events rather than scientific experiments. Through these particular representations students are offered, as resources for their own meaning making, certain ideas about filtration: it is quite ordinary and not very 'scientific' and can be done. It is not something mysterious that just happens.

The final text in this resource column is taken from a worksheet given out by the teacher. It is the closest thing to an account of filtration in writing available to the students. It is interesting for a number of reasons. Firstly it configures the interpersonal element of the activity of filtration by addressing students as 'you' which differs markedly from the teacher's interpersonal configuration shaped by the use of 'we'. Here there is an element of isolating the students as actors offering a greater level of autonomy. The suggestion of initiation, however, is still present as in the teacher's spoken input. This is reinforced by the overt initiation into the practices of science through the use of special terminology – *residue* and *filtrate*. Indeed the emphasis is on these words (themselves representations of filtration) rather than on the process itself. This mystification of the actual event of filtration is further reinforced by the way this written text handles the time element of the process of filtration. It first refers to the residue left *after* filtration and uses the present perfect tense for this completed action. In the second clause of the same sentence it returns to an earlier event – the dripping through of liquid that occurred *during* filtration. As such it evades direct reference to the event of filtration itself referring instead to the phenomena resulting from the process.

In applying a systemic functional analysis of this verbal representation of filtration it is interesting to identify the roles of different represented participants. In the first clause of the sentence the actor is represented by the word 'you', the goal by the

words 'a mixture' and the transaction by the word 'filtered'. In the second clause the 'liquid part of the mixture' is the actor and 'drips' is its non-transactional action. Because the mixture is both the goal of one action and the actor of another it is referred to as the relay and the process in which this change occurs is a (non-agentive) conversion. This verbal representation of filtration, then, emphasizes the change in state of the mixture.

In the second column are fragments of student dialogue recorded while they were at work on their model. The first extract is from an early stage where students were deciding which separation process they would choose to represent. They had been discussing for some time the possibility of 'showing' different processes. There is a high level of assumed responsibility implicit in the use of 'we'. Their concern, however, is not with *doing* filtration but with *representing* (showing) it. Their sense of responsibility and subsequent resolve is reinforced in the second extract where the students agree on the basic structure of the model 'We're going to put...and have ... and the red stuff will stay ...'. The language structures attribute a high level of agency and control to the students themselves. There is also solidarity amongst the group as student A completes the statement made by her colleague. This decision took some time to arrive at and the sense of volition is strong in their words. Significantly they too opt for an evasion of the process by focusing on the end product. They express what their model will show using the future and present perfect tenses: 'the blue stuff will go down and the red stuff will stay to show that they've separated.' There is an evasion of the event of filtration itself.

Extracts from the post project interview provide more evidence of the difficult decision making process the students were engaged in. Firstly they had a sense of wanting to go further in their representation ('we wanted to show a bit more') – to make visible what had so far been invisible to them i.e. the microscopically small separation of particles that happens during filtration. They came up against a problem, however, in their three dimensional representation – how to ensure that only some of their model particles passed through to the bottom. Having decided it was 'impossible' to make only the blue particles go through, they agreed on the need to intervene ('So we just had to pick them out again'). The students were satisfied with

this solution to the problem they had encountered – it resulted in the desired outcome – showing filtration.

The final extract in the second column here refers back to the students' choice to work with a three dimensional model rather then a flat visual. In fact they were the only group in the class to produce a three dimensional model of filtration. Again the main criteria for making this choice were to do with the desire to 'show' as much as possible. The flat visual, it was decided, would involve too great a number of participants and would lose clarity ('it would be like loads of things all over the page'). There is a sense here of the three dimensional mode being a more efficient means of representation. Also, as seen from their final presentation, the 3D text could be incorporated actionally in to a larger representation showing the particles in different places at different times in a way that a drawing could not.

In the final column the filtration model becomes a prop in a temporary group text which utilises the modes of action and speech. The students arrange themselves behind the desk and talk through the process of filtration with the conventional delivery patterns of a science teacher – they provide a running commentary of their actions, preface the explanation with 'now' and address the student audience as 'you'. The action is carefully orchestrated with each student having a particular role – one to introduce the presentation, one to do the commentary, one to show the solid particles to the class, one to show the liquid ones and so on. This text replicates a conventional teacher demonstration as students work together in body and speech to create a kind of composite science teacher.

In their representation of filtration the students choose to use all the specialist equipment – the filter funnel, flask and filter paper. With such prominence given to the equipment and the use of the passive voice in the spoken part of the presentation, a new relationship between represented participants in the action process is established. In the visual representation the equipment itself is the actor and the goal a mixture of particles. The students only speak of themselves as actors in relation to the activity of representation (*showing*) – not to the activity of filtration. It is in this capacity – as agents of showing - that they intervene in the presentation to manually separate the

particles and give a verbal explanation. The ideational configuration of this verbal representation of filtration is highly complex.

> *Now when water is filtered through with the sand, the liquid particles go through the filter paper to the bottom – as you know we can't really show it – and the solids are left at the top.*

In the first part of the statement 'water (with the sand)' is clearly the goal of the action represented by the word 'filtered'. In the second part of the sentence the 'liquid particles' (synonymous with 'water' in the first part of the sentence) become the actor in a further action. They 'go through'. At least part of the goal of the initial action, then, becomes an actor in its own right showing that there has been conversion and a change of state. The other part of what was initially being acted upon is now represented by the words 'the solids'. These remain the goal of an action; this time the action of being 'left'.

The students' presentation text as a whole (final column) is an elaborate orchestration of different modes (speech, action and the three dimensional model itself) which configure the event of filtration in different ways. Recognising that the model itself cannot represent the actual event of filtration ('as you know we can't really show it') the students use other modes to complement what they *can* represent in the model.

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6.2.2 Classificational Processes

Figure 6.2 tracks the classificational processes in the representations of filtration. There is one classificational process – a covert taxonomy - at work in the representation of particles. It serves to represent the fact that there are two groups of particles present. It is also inferred that there is a wider range of particles within the broader taxonomy of which the generic particle is the superordinate.

The concept of duality in relation to particles is made available to students through various resource texts, two of which are shown here. The first resource texts is a written extract from a mass produced worksheet - part of a science revision programme linked to a high profile education strategy of the government (DfES, 2002). The required student response to this text is to fill in the missing words correctly. The particular sentence included here consists of two balanced clauses; one referring to the solid part of the mixture and one to the liquid. The construction of each clause is similar 'the solid ... is called the ...' and 'the liquid ...is called the ...'. In spite of other differences in the two clauses there is sufficient equivalence for duality to be firmly established. The second text, a visual representation on the whiteboard, relates not to the duality of solids and liquids but to hot and cold particles in a different separation process - distillation. It is a close up of the whiteboard diagram referred to in the previous section. Here the understanding of particles as a group of two is reinforced visually by the two circles – one labelled hot and one labelled cold. The hot particle is red and the cold one is blue. Although this hot/cold distinction is different to the solid/liquid distinction it maintains the conceptual link between particles and the existence of two, comparable groups. Lastly there is the important resource of colour coding which serves to differentiate one group of particles from the other, in particular red and blue, colours frequently used in science.

In the second column the students discuss their particles and quickly realise they need two groups 'the particles of water' and 'the particles (that) are solid'. In discussing how to show these differences the move to colour coding is seamless – 'you mean like... we need some colours for that'. The suggestion from student D to do the liquid particles in blue is quickly followed by a parallel suggestion to do the solids in red and this is not contested.

In the students' presentation of their model the equivalence of the two groups of particles is represented in the modes of gesture and speech. The photograph shows two different students holding out handfuls of particles to show them to the audience. One has the blue particles and one the red. Their gestures are similar – both hands are cupped and are held at a similar height and distance from the body. The quantity of particles in each handful is also similar. Finally this equivalence is also evident in the sentence structure used by the narrator - two equally balanced, matching clauses.

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6.2.3 Analytical Processes (particles)

As analytical processes the representations in figure 6.3 are all concerned with essential characteristics – in this case those of particles.

In the resource text column are three gestures each of which represents a defining characteristic of particles. The gestures were produced while the teacher was talking and the complimentarity between the modes is apparent. In the first example the teacher foregrounds one particular feature of particles – their size. To reinforce this actionally, he holds his forefinger and thumb very close together to indicate something extremely small. Without the gesture the words could apply equally to largeness in size. Without the words the gesture would not be known to refer to particles. Hence the signs in the two modes operate in conjunction and students are given the opportunity of experiencing the representation by both seeing and hearing. In the second example there is a similar relationship between the two modes. The key characteristic is the circular shape – this is shown in the gesture but is withheld from the speech resulting in the students being visually focused on the gesture. Only after a student's response does the teacher reinforce the key characteristic in words – 'A circle, round circles'. Another element of the teacher's gestural representation of particles here is the characteristic of being more than one. His gesture consists of two circles and the word circle is repeated in the plural. Being made available to students is the additional idea that particles are to be thought about in groups, not individually. Lastly the teacher spreads out his fingers as if handling something light and fluffy. Again the meaning of this gesture is fixed by the accompanying word 'cloud'. The gesture, however, serves the purpose of evoking the imaginative experience of touching a (greatly enlarged) particle.

The second text in the resource column is a whiteboard diagram of the process of separating a mixture by distillation. This text is included here because it is a resource for the representation of particles which can clearly be seen as irregular, circular and numerous. Finally, there is an extract from the teacher's instructions to the students in which he and the class come up with a list of possible materials for making particles. The instructional language here does not include the word *show* (as in the instruction to 'show' the process of filtration). Instead there is an implied acknowledgment of artifice – 'You could make …' and an allusion to a range of imaginative possibilities.

In the second column there is an extract of dialogue from early on in the production lesson. Students discuss what they are going to 'use' for the particles. Again there is an element of volition and imaginative freedom implied by the word 'use' and the subsequent ease of discussion. The idea of using 'little bits of paper' is discarded in favour of the cotton wool. The students have clearly opted for the material that has the potential to embody the greatest number of desired characteristics i.e. cloud-likeness as well as being small and circular. They also, in the spirit of an imaginative, creative experience, opt for the material which will be most fun to work with. In the photograph the students can be seen all fully absorbed in the making of their particles – pulling off bits of cotton wool and dipping them in to paint. The association between fingers – the sense of touch - and particles is prominent. Finally there is an extract from the post-project interview in which one of the students refers to the text book convention of visually representing particles as circles. The use of 'every time' and 'whatever' reinforces the perceived extensiveness of this convention.

In the final column there is a close up (with a pencil to give a sense of scale) of the model particles themselves. As can be seen they are essentially round and irregularly shaped (cloud like). They also vary in size – no attempt having been made to regularise them.

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6.2.4 Topographical Processes (particles)

Figure 6.4 tracks topographical processes in representations of particles – those concerned with size and quantity. In this case the particles, which are invisible to the human eye, are microscopically small and too numerous to be counted. Given the impossibility of directly experiencing particles by seeing them, their representations are particularly important as resources for the students in their model making.

In the first column the same whiteboard diagram of distillation appears again – this time as a resource for representing the size and quantity of particles. In this diagram particles (whether hot or cold) are represented as being all of a similar size, evenly but randomly spaced and, in a general sense, numerous. There is no key (as with the hot/cold colour coding) to make explicit the topography – the proposed relationship between the represented sizes and quantities and real particles. Indeed the relationship is too loose to be fixed in this way for one circle in the diagram represents an unspecified, but very great, number of particles. The size of real particles is far too small for a precise correlation. This being the case, each individual circle is understood to represent an uncountable, large number. A further element of meaning in the represented particles is established through the fact that they are not ordered but are randomly spaced. They have no set positions and are therefore capable of movement.

The second resource text comes from the verbal element of the teacher's demonstration of filtration. Here the teacher, prompted by a question from a student, reinforces the notion that particles are so small that it is impossible to be precise about their size. He uses an everyday word ('tiny') instead of a more scientific word (for example 'microscopic') and repeats it in a colloquial fashion. Representing the smallness of particles is, in this sense, a straightforward rather than a scientific matter.

In the second column are two fragments of students' discussion which show how they handled the task of representing the sizes and quantities of particles. In both extracts they acknowledge the fact that in real life the process is invisible (because the particles are too small) and that making the particles *visible* is central to the task of showing filtration. Although they do not talk about particles here, it is to the topographical process in their representation that they refer when they say 'we wanted

to show a bit more'. The students' use of the comparative sets up a contrast between the real life event of filtration (in which the process is invisible) and their model. Recognising the impossibility of observing filtration in real life they decide to 'show more' of it by making the invisible particles visible – the separation of these particles *is* filtration.

From the second spoken extract it is apparent that the students had a concept of a size relationship between their represented particles and those of the real world. 'We've kind of magnified it about a million times'. The words 'about a million' denote an uncountably large number and the student is comfortable with this lack of precision. According to student B, knowing the precise scale of their model particles is something they are not yet good enough at science to know.

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6.2.5 Analytical Processes (equipment)

Figure 6.5 tracks the analytical processes representing the equipment used for filtration. The tracking of this representational process is informed by that of the earlier overarching narrative process (see fig 6.1) in which the students choose to give the equipment significant prominence as the agent (actor).

In the first photograph the teacher stands at the front of the class holding a student's exercise book to his chest. While speaking, he points to a page on which a number of diagrams appear. As he refers to the different processes for separating mixtures he points to the corresponding diagrams in the exercise book. As he does so he uses the word *those* establishing a direct correspondence between the visual images of equipment and the processes themselves.

The second resource text is a very short extract from the worksheet referred to earlier. Agency here resides with the students (addressed as 'you') and there is a reinforcement of the personal form of address maintaining, at an interpersonal level, a kind of master/apprenticeship relationship. Most significantly, however, in terms of the analytical process, the equipment used for filtration is described as 'filter funnel and paper'. The flask is not mentioned nor is there any reference to how the two items are to be spatially arranged (for example the written text could have read 'You use a filter paper *inside* a funnel'). Rather there is an implication of equivalence and separateness in the use of 'and'. This contrasts with the text book visual representation of filtration equipment in which the conical flask, filter funnel and filter paper are shown in a particular spatial relationship in a state of disassembly. The different pieces of equipment are given equal status in that they all bear labels of the same size and print type. The filter funnel and filter paper, however, are outlined in reduced ink which appears grey while the conical flask is outlined in black. The reduced ink represents transparency. The filter paper is shown in two states – as an unfolded circle and as a cone. The shape and size of the cone match the upper section of the funnel which is also outlined in grey – the implication being that by laying one over the other, a black outline (equivalent to that of the flask), will appear. It is a visual invitation to imaginatively assemble the constituent parts.

The final resource for the students in representing the filtration equipment is a fragment of verbal text in which there is an exchange between the teacher and a student concerning the manipulation of the filter paper. There is the same interpersonal configuration observed earlier in fragments of the teacher's spoken language signalled by the use of *we*. The teacher's speech implies that there is one correct way to prepare the filter paper – it is the student who uses, with some uncertainty, the modal *can*. The teacher does not: 'see how we do it, fold it once'. There is also sequencing marked by the use of *then* indicating a conventionalised series of actions.

In the second column are five fragments of dialogue about representing the filtration equipment. A high proportion of the students' discussion focuses on this issue, their primary concern being the need to make the model equipment look realistic. They are most interested in the textbook visual - they point at it and refer directly to 'the book' during the group interview. In the second fragment of dialogue, it is the need to have all the constituent parts present that is being addressed. Following the early decision to show shape by making the representation three dimensional, manipulating the materials to achieve the desired shape becomes very important. In the third extract there is also a sense of the importance of assembling the parts ('we can stick it together'). Finally, according to the students themselves, the importance of choosing appropriate material was a great puzzle to which they applied themselves and came up with an answer; 'It took us a whole lesson to figure out'. In all these extracts there is a preoccupation with the need to get the representation of the equipment *right* – to find suitable materials and put them together correctly.

In their final presentation, the students refer to their model as a 'real replica of a model'. In this confusing epithet there is acknowledgment of both the hyperreality and the artificiality of their representation – a replica is a copy, not the original item. On the other hand it is real! As far as the students are concerned the model is real in that it complies with all the criteria they decided were essential for proper filtration equipment – it has all the necessary pieces, they are the right shape and size, they are transparent and they are assembled correctly.

6.3 Representations of Benin City

Six tracking semiosis grids will be presented here in relation to representation of the ancient city of Benin in history. Each grid concerns a different representational process and will be followed by detailed commentary and analysis.

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6.3.1 Classificational Processes

Figure 6.6 tracks the classificational processes in representations of Benin City. The resource texts in the first column offer two taxonomies. In the first text the picture and caption present a covert taxonomy in which the superordinate (inferred but not represented) is a generic building. Two types of buildings are represented both visually and verbally in the first text; those that are part of the palace and others. Together these two types of buildings cover the entire area of the city – the palace buildings taking up half this space. Visually the Oba's palace clearly occupies the left mid-ground of the picture and has a distinct shape. In the background to the right is an area equivalent in size occupied by a large number of smaller buildings. Among these a few evenly spaced larger buildings stand out. In the foreground are representations of people in a celebratory procession. There are no buildings here – boundaries (fences and walls) marking off this area as being outside the city.

Five further texts were presented to students as artefact evidence. Here there is a second taxonomy – the different trades and crafts. In its entirety this classificatory group consists, according to the written text, of 'about fifty' different trades and crafts. The title card acts as superordinate by referring to the group as a whole. A small selection of subordinate trades and crafts (four) are represented visually and verbally on similar cards. Together this group of cards establish equivalence between the trades and crafts. All cards are blue in colour, they are similar in size and the images have been reproduced in a similar way. Reinforcing uniformity, the same sentence structure is repeated in the caption on every card – the name of the trade or craft being the one substitutable element. This repeated caption uses the word 'district'.

The final text in the resource column is a chalkboard plan of a student's house – created as an example of how to draw a bird's eye view plan. It appears as a rectangle subdivided into regular geometric shapes or sections. It has one large section at the top (approximately a third of the space) below which are a number of smaller sections arranged around a vertical axis.

In the second column is textual evidence of the development of classificational processes in the students' work. The rough sketch shown first is a visual transduction

of the written evidence text (see fig 6.7). It is spatially organised in to roughly equivalent, geometric sections with a vertical axis (the main road). The taxonomy here relates to the visual classification of the roads and the spaces between them. There is one main road of significant width which dissects the sketch vertically (the superordinate). Extending from this on both sides are five subordinate roads of equivalent length and width. All subordinate roads are lined on both sides with rows of equally sized small squares (houses). The spaces between the roads are also equivalent in shape. Among these is the 'King's Court' occupying the bottom right hand space - approximately a quarter of the whole area.

In the section of the grid tracking representational activity, a photograph of the students shows them at an early stage of their work. The first represented participants to have appeared on the sheet are the roads and the Oba's palace (King's Court) which is now at the top and occupies about a third of the available space. In the extract from the post project group interview student D refers to this spatial classification as one based on the principle of wealth.

In the second photograph student A is gesturing with her pencil to indicate the different sections on the paper while her colleague talks about the need to classify and group the represented participants. Student A points out that by drawing the roads they have already segmented the space. The word she uses for the spaces on the paper is 'sections'. This word conveys the potential of the spaces on the paper to act as signifiers. The signifieds – the districts – are only attributed later. It is at this point that some of the trades: pottery makers, spear makers and ivory are selected. The cotton spinners are not included.

In the second extract of dialogue the word 'districts' is introduced. Here the students can see that by drawing the roads they have created spaces between them which have become represented participants in their own right. There are three of these and because they cover the whole area (excluding that occupied by the palace) they are referred to as 'three main things'. It is when student D identifies the houses which line the roads that student B confers on them the attribute of being 'districts'.

The extract from the presentation commentary in the final column clearly establishes the equivalence between the crafts and trades through the use of a repeated sentence pattern. That the selected crafts and trades are part of a larger taxonomy is indicated by the word 'altogether' and the reference to the total number - fifty. In this commentary the primary taxonomy of buildings (palace and ordinary people's houses) is also reinvoked. Interestingly, although the students state that the palace covered half of the city, visually it occupies only one third.

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6.3.2 Inclusive and Exhaustive Processes

Figure 6.7 concerns inclusive and exhaustive processes in representations of Benin City and tracks them from the resource texts through the students' representations to their presentation text (the principal artefact text). In the first column are a variety of resources some of which put forward the idea of representing the city as an inclusive process. Other resources that were available to the students, however, put forward the possibility of representing the city as an exhaustive process.

In the first column are two different resources – a visual artefact text and the written evidence. Both represent the city by means of inclusive processes - neither is structured as though it fully accounts for the entire city. Indeed the overarching representational process in the picture is not the city but the Oba's procession – a narrative process. The representation of the city is an embedded analytical process and it is positioned in the background; a viewing position which means a large portion is hidden behind the palace. Of the section that remains in view, the distance created by perspective affords only selective representation of larger buildings. Furthermore the city is not shown as ending or being contained within the borders of the picture – it is a limited, background view afforded by the position of the procession. The city itself appears to extend beyond the edges of the picture.

In the written extract the selection of attributes is shaped by the interpersonal configuration of the narrative. Being written explicitly from the writer's viewpoint (an eye-witness account) it includes only what was seen and deemed significant as the writer moved into and around the city - a selection process heavily influenced by comparisons with his native Holland. The text makes no reference to the city as a whole focussing instead on individual features and their proximity to one another. The viewing position offered in this verbal representation is neither from a distance (as in the picture) nor is it a bird's eye view. It is a close-up, gradually unfolding view from within.

In the teacher's instructions the students are clearly offered the possibility of constructing an exhaustive process – a representation of the city that leaves no blanks and assembles the parts to make a whole. Indeed it is not just a possibility but a requirement that their representation should be exhaustive. The teacher refers to 'the

whole thing' and the 'structure of the city'. The students are to be engaged the work of assembly, not selection. They will need to 'fit information together' and 'work out the structure'. Reinforcing this requirement to show the whole of the city is the use of a bird's eye view for the example – the student's house. This plan accounts for every bit of space and is the result of reasoned assembly of constituent parts; doors provide access and walls separate rooms.

A few texts have been selected for inclusion in the representational activity section to illustrate the kind of work undertaken by the students in relation to exhaustive and inclusive processes. The first text is the rough sketch transduction of the written evidence. By using a bird's eye view it visually accounts for all the areas of the city and is a work of assembly. The constituent parts have been spatially arranged within the boundaries of the page which is understood to represent the whole area of the city.

In the first two dialogue extracts students account for the blank spaces on their plan and in so doing work towards producing an exhaustive representation. They talk about the areas on the paper to which no attributes have been attributed – these are the 'parts' and the 'bits'. In order to transform these spaces in to signifiers they need to be 'filled up' and 'coloured'. There is, however, a tension here which emerges in the third extract: the students have been instructed to represent the whole city but to use only information they themselves obtained from the evidence. Student B raises concern about ensuring they include this information only and there is an understanding that the information they have is limited.

In the post project group interview the students are unambiguous - their representation is inclusive, not exhaustive. Student D says it is 'just the main section' – a partial representation including only the most important parts. Continuing with this inclusive thinking, student B compares the city of Benin to London in terms of their possessive attributes – they both have a palace, main roads, a forest etc. In spite of the commonalities the comparison is qualified: it is 'quite' and 'not, obviously'. In this extract the students exhibit unease at having visually represented the city as an exhaustive process. They also, however, take clear pleasure in being able to recount the common attributes and relate the experience of their own city to that of six hundred year old Benin.

In the final column is a short extract from an exchange with another class member who, during the presentation, questions the absence of walls on the plan. In their response, students B and C take the position that their plan does *not* show everything – only the evidence they had. In so doing they redefine their exhaustive visual representation – it is an inclusive process based on certain attributes only; those that the group members had evidence of.

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6.3.3 Topological Processes (access)

Figure 6.8 tracks the specific processes in representations of the city that concern topological processes as perceived in terms of access. Decisions about relative sizes and spacing have to be made when producing visual representations of any kind - it is a logic of the mode. In the first column texts have been selected to show how thinking about spacing in terms of access was made available to the students as a resource for their representation of Benin City.

The written evidence text firmly establishes a view of the city from an outsider going in and moving around. In the first sentence the writer is on horseback going in through the gate. It is understood that everything described from this point onwards was seen by him as he moved around. The verbal representation of the city is constructed around the account of this movement: 'I went...', 'as you go along...',' I went into...', 'I went in as far as ...'. Various different features of the city appear in this text. What determines their sequence and relation to one another is the view afforded by the physical access obtained by the writer. For example we read that the writer went along the main street and looked down other broad, straight streets on either side. Topologically this configures the main street as being long and wide with other streets proportionally narrower and shorter.

The artefact evidence picture is included here because it visually reinforces the idea of the city as an area within which people moved around. As has been mentioned, the picture is of a celebratory procession with a very large number of people emerging from the city. The interactive realisation of the image is social – the viewer is offered involvement in the procession; imaginative engagement with the city as a physical space to move around in.

The teacher's demonstration reinforces very strongly the invitation to imaginatively enter the city as offered by both the written and visual texts. Using a pencil or finger to stand for a person students are given the idea of testing the topology of their plan by walking through it. If the topology is configured logically, the imaginary walk will allow access to all parts of the city. This configuration of spatial relations is offered to the students as a resource in their representational activity. It is later emphasised

when the teacher invites the students to ask themselves if their plans, in terms of access, 'make sense'.

The rough sketch in the second column is also of interest topologically for, as has been noted, it gives particular prominence to the roads – the means of access to the city. The gate by which the city is entered is positioned at the bottom of the page with the King's Court on the right hand side of the main road. The main road itself dissects the page vertically and occupies about one sixth of the entire width of the plan. Two narrow roads are positioned leading off the main road on either side – they are evenly staggered. Each of these roads is lined with small regular squares representing houses. These roads eventually lead off the edge of the page. All the roads are straight and have been drawn with rulers. Visually, access along the roads, however, is blocked by the ruled lines. Also the roads extend as far as the edge of the paper, none of them leading to particular parts of the city. Altogether these elements of lowered modality give prominence to the spatial configuration. Topologically this sketch is more concerned with representing shape and relative size than it is with access. What is of interest here are the topological differences between the rough sketch and the presentation text in which there is access. Here no area is seen a 'blocked' and the roads do lead to destinations.

Some of the choice making which led to the changes from the rough sketch to the presentation text is shown in the representational activity section of the grid. The photograph, for example, was taken at a later stage than the drawing of the sketch. Here one of the students can be seen using her fingers to imaginatively walk along the main road of the city. Two other group members watch her doing this. A high proportion of the students' discussions are now concerned with issues of access. In the first extract students approach the issue from different perspectives. Student A's question implies that the plan has a purpose: to show how to get to the different parts of the city. Meanwhile student B's incomplete statement suggests that she is imaginatively walking around the physical spaces on the paper. Student A later offers a principle on which the positioning of roads can be based – that of access to important parts of the city. In the second extract students A and B use a shared, familiar real life experience to make sense of the access issue. The main road on the plan is imaginatively replaced with their local main road and its landmarks (chip shop,

traffic lights etc). There is no doubt at this stage that the students' primary concern in positioning the represented participants is that of access. There is a strong sense that the plan should not only show (like a map) how to get from one part of the city to another but that it should somehow make it possible. Students use the phrase 'going through' rather than 'going past' or 'going along' to talk about both the plan and their real life walk to school. This indicates a high level of imaginative involvement with the physicality and substance of their representation.

The final column shows how, in their presentation, the group were challenged by another class member to justify their visual representation in terms of accessibility. The concern here is that the palace (King's court) which should be walled off, is openly accessible. In response the group members use their fingers to show the point where access is restricted and belatedly attribute the signified *wall* to the border of the palace.

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6.3.4 Analytical Processes (Oba's palace)

In figure 6.9 the texts track representational processes in which possessive attributes of the Oba's palace are structured analytically. What is at issue here is the choice of possessive attributes and the ways in which they are assembled to represent the palace.

In the resource texts the palace is accounted for both verbally and visually. In the first text the picture, as discussed earlier, shows the palace behind the Oba's procession. From the quality of its reproduction and its style as well as the caption, the picture is presented as a highly valued piece of historical evidence. It is over three hundred years old and according to the caption comes from a book produced by a geographer whose representations would have the higher status of factual rather than imaginative work. In spite of this, the main representational process of the visual image is not a conceptual representation but a narrative representation of an event – a non-transactional action process in which the Oba and his procession constitute the actor participant moving across the page. Modality is high and the viewpoint is naturalistic with perspective and detail. The interpersonal construction is involved and social offering a medium range frontal view. Behind and above this the representation of the palace is an embedded analytical process. It consists of three interconnected buildings on a raised platform within a fenced enclosure. Each of these buildings has a triangular spire protruding from the centre of its roof. On top of each spire is a cross-shaped figure; a bird with outstretched wings. There is visual assembly of the different parts of the palace and a hierarchy of buildings determined by their height. For many viewers the skyline with its protruding towers and crosses could be said to resemble a northern European town scattered with church spires.

The second artefact evidence text is a sketch showing the roof, supporting columns and decorative plaques of the palace. It is a conceptual representation of a selected characteristic of the palace. No other part of the city appears in the resource texts in this way – there are no drawings or diagrams of, for example, the palace courtyards, prison, stables or galleries. In addition, a specific attribute of the palace that has been highlighted (the presence of bronze plaques) is one that can readily be associated with other, more generalised characteristics. The plaques are not functional but for adornment signifying sophistication, wealth and civilization. The text in which the

plaques appear is typically analytical. It invites the viewer to scrutinize the attributes of the carrier – in this case not the palace as a whole but a section of it. Modality is lowered – there is no lifelike background, perspective or shading. The labels and the title explicitly offer this text as a diagram of the kind usually associated with scientific or factual representation. There are no people depicted. Unlike the Olfert Dapper picture, however, this visual representation does not have the authenticity of age and the accompanying status of historical evidence. It is not a commercially produced text but has been created for a specific event and purpose (the lesson) with a particular audience in mind (the students). However one of the key defining characteristics of the audience is that they have seen the plaques on display at the British Museum. This being the context, the status of this second artefact text is greatly enhanced.

As described earlier, the written evidence text is an eye-witness account of the experience of moving into and around the city. Consequently the attributes of the palace included here concern size, space and position. The vocabulary reflects this: 'within', 'around', 'through', 'at the right hand side', 'surrounded by', 'which encircles' etc. The attributes themselves are represented by unmodified nouns: 'courtyards', 'galleries', 'sentries', 'court', and 'wall'. There are few adjectives and no descriptive detail other than information concerning size and shape: 'very large' (of the palace), 'square' and 'four' (of the courtyards). The modality here is also lowered with a scientific emphasis on facts.

The tape recorded oral evidence has also been included here because it offers students an important resource for their analytical representation of the palace – the presence of charms to protect from evil. Like the first artefact text it also gives prominence to Oba Ewuare, the palace builder and occupier, and his activities. Just as the diagram of the plaques foregrounds the more abstract notions of civilisation and sophistication, the oral text foregrounds ideas about power and order achieved through conflict. These are broader concepts but they also serve the students as resources in their work of representing the Oba's palace.

Texts in the second column are offered as evidence of the students' visible and invisible representational activity. The first of these is a rough sketch of the palace copied from the artefact evidence picture. In the sketch three buildings with

triangular spires are present in a spatial relationship. A fence and gate are partly depicted and on top of the spires are crosses. This rough draft visual representation shows only the buildings of the palace, not those of the rest of the city. In the foreground seven stick people represent the crowd among which the Oba is distinguishable by his enlarged headpiece. At this stage, the Oba himself is an important representational presence – standing as he does, in front of his palace. The Oba is frequently referred to by the students (as 'the King') and is influential in their representational work.

The second rough sketch is the bird's eye view plan based on the written evidence described earlier. Here, as has been noted, the representation is exhaustive – all of its space is taken up with possessive attributes; the sheet of paper representing the area covered by the city. It is onto this terrain that the route and landmarks referred to by the writer are plotted. This transduction of the written account begins at the edge of the page with the writer's entry in to the city. The road along which he passes extends upwards towards the top of the page with roads lined with houses leading off on either side. In keeping with the written account and this particular spatial representation, the Oba's palace (labelled 'King's Court') appears in the lower right section. Although it is large it covers only about a sixth of the total area of the represented city (not half as in the written resource text). It is square in shape and occupies a space between roads and the gate. Here the process of representing the palace has been a matter of designating a signified (palace) to a pre-existing signifier (space on the paper).

In the photo of the students at work they are looking at the position and appearance of the palace on their plan. At this stage only two features of the palace are visible: its shape and size. It is unclear to student D what her colleague is drawing and there is uncertainty about what is being represented. The representation – an outlined space on the paper can only be referred to by pointing to it on the sheet. It has not yet fully become the palace is only identifiable by its position in relation to other represented participants. In keeping with this state of emergence, student A has no words to explain why the representation is the castle but refers, instead to 'how it looks' i.e. large and rectangular with sections. There is felt to be a paucity of information and an air of uncertainty dominates the discussion. The word used to refer to the represented participant is 'castle' which, unlike 'palace' has a familiar set of meanings (including

the presence of defences and facilities for imprisoning enemies). Although it does not appear in the resource texts, 'castle' is the word most often chosen by students to refer to the Obas's dwelling during their representational activity.

In the first two extracts of dialogue students respond imaginatively to the absence of evidence in the resource texts by creating their own attributes for the palace; a throne and secret passageways. Neither of these is mentioned in the resource texts although they are, in the individual students' minds, possible criterial characteristics which need to be considered. The suggestion of a throne is not taken up by the other group members. Concerning the secret passages student D asks 'what if ..?'. Student C, however, does not share the same interest and chooses instead to reassert the prescribed methodology: that of only using information acquired from legitimate evidence. Student D makes a passionate justification for the secret passageways in spite of the fact that they are not present in the resource texts. For her, they are a defining characteristic of castles / palaces. There is, however, no representational imperative for the students to include additional possessive attributes – the palace is eventually shown on the plan without the throne or the secret passageways.

In the final extract student D re-reads her notes from the oral evidence in an attempt to resolve a recurring problem. Students A and B, sensing they have reached an impasse, are anxious to find a way out. The evidence does not, however, provide the hoped for information about the *position* of the gateways necessary for their visual representation. On this occasion there is a representational imperative. Making a commitment to position is a requirement of the visual mode in which they are working and a decision has to be reached. Eventually after considering the two possibilities; to the 'castle' or to the 'whole city', student A creates a justification for positioning the gates at the entrance to the palace. She says, 'They're trying to look after the king and queen'. The students have been forced to imagine a scenario to enable a decision about the position of the gates to be made. This response to the representational challenge is constructed around a set of circumstances in which 'they' (the people of the city) are bound by duty or devotion to care for their 'king and queen'. The relationship between the Oba and his subjects that they imagine is a benevolent one.

In the final presentation text the representation of the palace is an analytical process with two kinds of participants; the carrier (the palace as a whole) and its possessive attributes (the prison cells, King's court, Court Yard, walls and gates). It covers a third of the area of the city and occupies the dominant position at the top of the plan and is no longer positioned to the right of the main street. The central King's court is an outlined area with a thick purple border - the walls. The central area is filled in with bright red colour. The walls also partly segment the King's court into four sections. To the left is a strip of four square sections labelled 'Prison Cells'. They are shaded grey and are covered with a criss-cross pattern. To the right is a strip of green scattered with brown leaf shapes and other representations of vegetation (not as dense as the forest). This area has been labelled 'Court Yard!' and represents a garden. Both the prison cells and the courtyard are represented as carriers in their own right with possessive attributes; the grey criss-cross pattern representing bars of prison cells and the green and brown design representing vegetation in the court yard. The central court itself, however, is represented differently. As in the second sketch the main body of the palace continues to be represented without its own possessive attributes. In keeping with this, the palace (as distinct from the courtyard and prison cells) with its outline and filled in colour is represented as a space bordered with the attributes of walls and gates. In the centre at the bottom there is a gap in the purple outline in front which is a row of black lines with a large cross. While the black lines do represent the gates in the spatially structured analytical process, the cross operates differently. It is particularly prominent and represents symbolically, rather than analytically, the criterial characteristic of being protected from evil. As such it complements but is not part of the analytically structured representational process.

In the verbal commentary the word palace is used rather than castle. 'Castle' served as a conceptual tool during representational activity but in this formal context is replaced by the officially sanctioned 'palace'. In its grammatical structure the verbal account confers status on the palace. In the first sentence it is active – it '*covered* half of the city' and in the remaining sentences is cast, analytically, as the possessor of attributes – it 'had inner walls' etc. Consistent with the visual analytical process it offers few possessive attributes and is very brief. Unlike the visual account, however, in which the palace covers a third of the city, the verbal account states that the palace

'covered half the city'. It is the verbal which is consistent with the resource information.

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6.3.5 Symbolic Suggestive Processes

The symbolic suggestive processes are those which establish what the carrier means or is through the mood or atmosphere of the representation itself. Figure 6.10 tracks the symbolic suggestive processes from the resource texts to the students' presentation text. The kinds of meanings established by symbolic processes are often emotive and affective rather than rational or logical. As such the senses are more directly involved than with other representational processes. Viewing the artefact evidence picture, for example, creates a sense of the antiquity of the city of Benin. It requires a different kind of viewing to a more modern image – one that anticipates more time being spent looking closely at the dark, indistinct, minute detail. It is slightly faded and bears the shadow of a fold in the centre – a reminder that it was originally presented on the pages of a book. Being black and white, hand drawn and with a level of detail associated with the leisurely work of a pre-digital age, it is clearly old – an authentic historical artefact. Its darkness and areas of shadow also evoke a mood of complexity, mystery and possible danger.

The extract from the tape recorded oral evidence is included as a resource text because of its references to the supernatural ('charms') and evil. It deals largely with the fact that the Oba was under threat and needed protection from his enemies. There is a strong sense of danger and of the unknown. This sense was reinforced for students during the lesson as sections of the tape were replayed numerous times to identify the words which were spoken with a strong African accent.

The absence of colour in the resource texts is an important feature of the so-called archaeological evidence (black and white photocopied images with captions mounted on yellow card). Included among these texts is information about the rainforest environment in which the City of Benin was built. The absence of colour and the lack of detail afforded by the medium of reproduction contribute to the dark, unknown quality of the representation of the forest. Dense layers of vegetation, however, are visible from the photos as are the expanses of water – both of which are suggestive of unknown, hidden dangers.

The African style drawing of the house was also presented to students as archaeological evidence – perhaps an artist's impression based on archaeological

finds, or a drawing of a traditional house of the kind built in the 16th century. This drawing does not, however, embody the same mood of antiquity, or of danger found in other resource texts. There is significantly less detail, and the style of drawing is naïve creating a sense of simplicity and openness. The reproduction has not faded and the contrast between black and white is sharp. There is definition and certainty both in the physical experience of looking at the picture and in the mood or sense it evokes.

The first dialogue extract and photo of students at work in the representational activity section provide evidence of their dominant orientation; towards the use of colour. It is imperative that they choose a colour, and a means of application, for every represented participant. These choices are partly shaped by the availability of materials – the felt tip pens and crayons on the table in front of them, but also by the symbolic values and qualities the students associate with the various represented participants. Some of these associations are stronger than others. Faced with the impossibility of representing the courtyard with a drawing when she has no knowledge of its characteristics, student D decides to restrict representation to the mode of colour. In so doing she is able to invoke a whole range of symbolic meanings. In response to her question; 'what colour's the courtyard?' student A assigns a new, more familiar word – 'garden'. In so doing sets up an automatic association with the colour green and all its symbolic associations with the natural world, vegetation, grass and leisure.

In the second extract student D immediately associates the colour red with the floor of the palace – she does not, however, verbally articulate the concept of the royal red carpet, and the other students do not initially support her representational interest. They go on to discuss, in a more general way, which colours can be used to represent the quality of being royal. During this discussion the felt tip pens and crayons (except for 'gold') are lying around on the table. The symbolic associations of the colours are experienced physically, not in an imaginary way, as they look at and try out the different coloured pens.

The importance attached to colour by the students is amplified by student D's enthusiasm in expending considerable time and effort in colouring in the entire area of the inner court. There is no shading or blending of colours, just one block of red –

sufficient in its own right to confer on the carrier the necessary symbolic qualities. There is no complexity; no blending or layering of colour. In contrast to this, the forest is the domain of significantly more representational possibilities and complexities. In the third extract of dialogue the students engage imaginatively with the forest putting forward suggestions: 'If they have...' 'Shall we have...'. In the later interview student A, referring to the many colours used for the forest, implies that the darkness of the forest was the result of combination and variety; 'we put all different colours in it'.

In contrast to the resource texts, colour dominates the presentation text. Its symbolic meaning operates in several ways. Firstly, there are the prevailing cultural colour associations with which the different participants are identifiable; the lake and rivers are blue, the courtyard (garden) and forest are green, the prison grey, the palace red and purple and the roads grey. Secondly there are the less conventionalised but equally important moods or atmospheres evoked by the colours and the ways in which they have been applied. Although symbolic suggestive processes dominate the appearance of the final representation little discussion concerning the use of colour occurred during representational activity. Not surprisingly this is consistent with the operation of symbolic processes; they are sensual rather than rational, spontaneous rather than logical and therefore less inclined to be verbally mediated than other processes.

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6.3.6 Symbolic Attributive Processes

The symbolic attributes that are tracked in figure 6.11 are the verbal and visual labels that represent the meaning or identity of the participants to which they are visually related. The Christian cross which appears in the final presentation text, a symbolic attribute without a related participant, is also tracked from its origins in the resource texts.

In the resource texts captions and labels occur in several forms. The resource texts have in common full sentence length captions which relate to and identify what is being shown. Unlike the labels which connect verbal realisations of participants with visual participants relations are established through the convention of positioning the caption text below the image. The captions also establish a particular kind of interpersonal relationship – the viewer is the addressee and the recipient of explanations. The captions, in this sense differ from the titles; they are full sentences and can be read independently from the visual representations.

There are two examples among the resource texts of visual representations with verbal attributes (written labels). These both make use of pointers with arrow heads. The written text is unframed and of a uniform size and style and is hand written in lower case, without capitals and in black ink. These verbal labels are evenly spaced and equidistant from the visually represented participants to which they relate.

In the representational activity section there are two items which include evidence of the development of the cross as a symbolic attribute. The rough sketch from the artefact evidence shows the presence of Christian crosses on top of the palace buildings. It is to this drawing that student C refers in the first extract of dialogue. At this stage the gateways (not yet represented visually) have been identified as the site of evil spirits. This case having been made, an opportunity is afforded by prevailing cultural symbolism to identify the previously unnamed shapes which appear above the gates in the sketch. Hence the shape is referred to by student C as 'a cross or something'. From this point on the gates become sites, not of evil alone, but of the conflict between good and evil.

In the extract from the post project group interview the students are asked about the cross at the entrance to the palace. They have only a partial explanation for it - one saying that it was an unconscious decision ('just felt like drawing it') and another that it was a symbol to stop evil spirits. The language of justification continues ('we thought they must have ...' and 'they were supposed to ...') and is particularly strong with reference to the quantity and position of the gates. This response is an attempted retrospective rationalisation of their symbolic representation (the cross). When it was created, however, this sign was the visual realisation of unreasoned, affective cultural association rather than logical, rational thought.

Extracts of student dialogue in the representational activity section concern the development of decisions about the use of labels. Unlike the symbolic suggestive processes, where thoughts were rarely articulated, there was considerable discussion between students concerning the symbolic attributive processes (labels). These discussions involve a degree of reasoning and rationalisation not present in the production of the suggestive processes.

In the first extract student D is faced with the impossibility of drawing something which she does not have a mental image of; a part of the palace. 'Colouring it in' is a substitute for representing it analytically with a set of possessive attributes. Aware that this representation may be less than adequate for the requirements of the task, student B suggests writing the word 'courtyard' directly onto the area before colouring it in. This action requires no further knowledge of what a courtyard actually is but serves to increase the validity of the representation.

The second extract refers to the opened-up view of the ordinary person's house; a visual symbolic attribute connected to the bird's eye view of the house. Here, in contrast to their experience above, the students *do* have a mental image and express a desire to make that image into 'knowledge'. According to student B the activity of drawing it will actually create the knowledge – 'we should draw this so that we know...'.

The third extract refers to the 'house without a door' label. On this occasion there is less certainty indicated by the modal 'might' (rather than 'should' for the previous

example), the qualifying 'like' and the diminutive 'little'. In seeking to give weight to her suggestion student B invokes the higher authority of published material. The sign could be 'like the book'. Nevertheless student A's response is not positive. When student A responds by saying 'Isn't that going to be weird?' it is impossible to tell whether she is referring to the appearance of the label (the 'sign') or to the idea itself (that the occupiers of the houses used windows rather than doors for access). In spite of the uncertainty surrounding this particular representation, the imaginative work of visualising this particular use of the windows had been done and it did appear in the final presentation text.

The final two extracts concern the use of 'pictures' (iconic symbolic attributes) to relate to the different districts. The fact that the spear makers district is considered to be in need of one of these while the ivory district is not, reveals how they operate. What makes the ivory district different is that it occupies twice the space of the other two districts and it has a unique possessive attribute; the elephant herd. One operation of the pot and spear symbols, then, is to confer comparable uniqueness. Another operation is to identify each district by association with its products. This being the case, the precise appearance of the symbols is not at issue 'Just draw a pot ...'. The elephant herd, however, is not an equivalent symbol to the pot and the spears; it is not a product. Indeed the imaginative work of visualising an ivory workers' product is much harder; there being no readily available resources either in the given texts or the wider culture to facilitate this.

In the presentation text the information load is shared between the visual and the verbal; the written labels or symbolic attributes of the visual represented participants to which they relate. These symbolic attributes are particularly prominent in the presentation text and although they are verbal (written) representations they also operate visually in their own right. As such they are integral to the (spatial) visual presentation; not part of the separate (temporal) verbal commentary. They were not read aloud during the presentation itself; but remained as visual offerings to be read by viewers of the visual presentation. As symbolic attributes in the visual process the size, font and framing of the labels operate as signifiers in their own right. For example, the label 'King's Court' not only represents verbally the entity which is visually represented by the red square but also indicates the level of contentiousness

present in this representation. In this case there is a very low level of contentiousness, for, as has been discussed in chapter five, the verbal symbolic attribute is direct, being written in capital letters without a frame directly on to the visual participant to which it relates.

Chapter Seven
Process Charting

7.1 Introduction

This chapter, in focusing on the occurrence of representational processes, approaches all texts as configurations – as reconstructions of experienced phenomena (Halliday, 1985). In the case of the students' representation of Benin City, the experience was largely textual consisting of resources made available by the teacher. The most direct element of the students' experience of Benin City was their visit to the British Museum where they viewed the brass plaques from the Oba's palace and other artefacts removed from the site of the ancient city. In science the experience on which the representation was based differed in that, in addition to the textual representations of filtration in the textbook and worksheet, the students also had the direct experience of observing the filtration experiment conducted by the teacher. Although invisible to the naked eye, this real-life experience was significant for subsequent representational activity.

Even though experience of the objects to be represented differed in the two subject areas, both experiences were shaped by the representational processes through which they were made available. This is as true of the configuration of the filtration experiment as it is of, for example, the textual structure of the labelled diagrams in history. Both were created according to the particular ideological interests of those responsible for their representation. One way of understanding this ideological shaping of resources on offer to students, then, is to examine the occurrence of different representational processes. The nature of these processes and their operations have already been described in chapter four and extensively illustrated in the previous chapter. Here the same representational processes will be abstracted to enable systematic charting of their occurrence across both the resource and the students' texts. Patterns will then be observable in the students' choice of representational processes *in relation to* those offered in the resource texts. Of particular interest will be contrastable incidents of innovation and duplication.

7.2 Representational Choices in the Filtration Texts

Comparative system networks will be shown for three representational processes occurring in the filtration texts: narrative processes, classificational processes and analytical processes. Two system network diagrams will appear for each process with the relevant choices highlighted in colour. In each case the first network will indicate choices occurring in the students' text and the second those occurring in the resource texts. This sequence (a reversal of the chronology of tracking semiosis) is intended not only to reveal similarities and differences in the representational configurations of the resource texts and those of the students but, most importantly, to draw particular attention to the students' conformity with or deviation from the resource texts. Each network has its own commentary and each pair of networks (e.g. narrative processes in resource texts and narrative processes in the students' text) is followed by observation and analysis of the insights afforded by their juxtaposition.

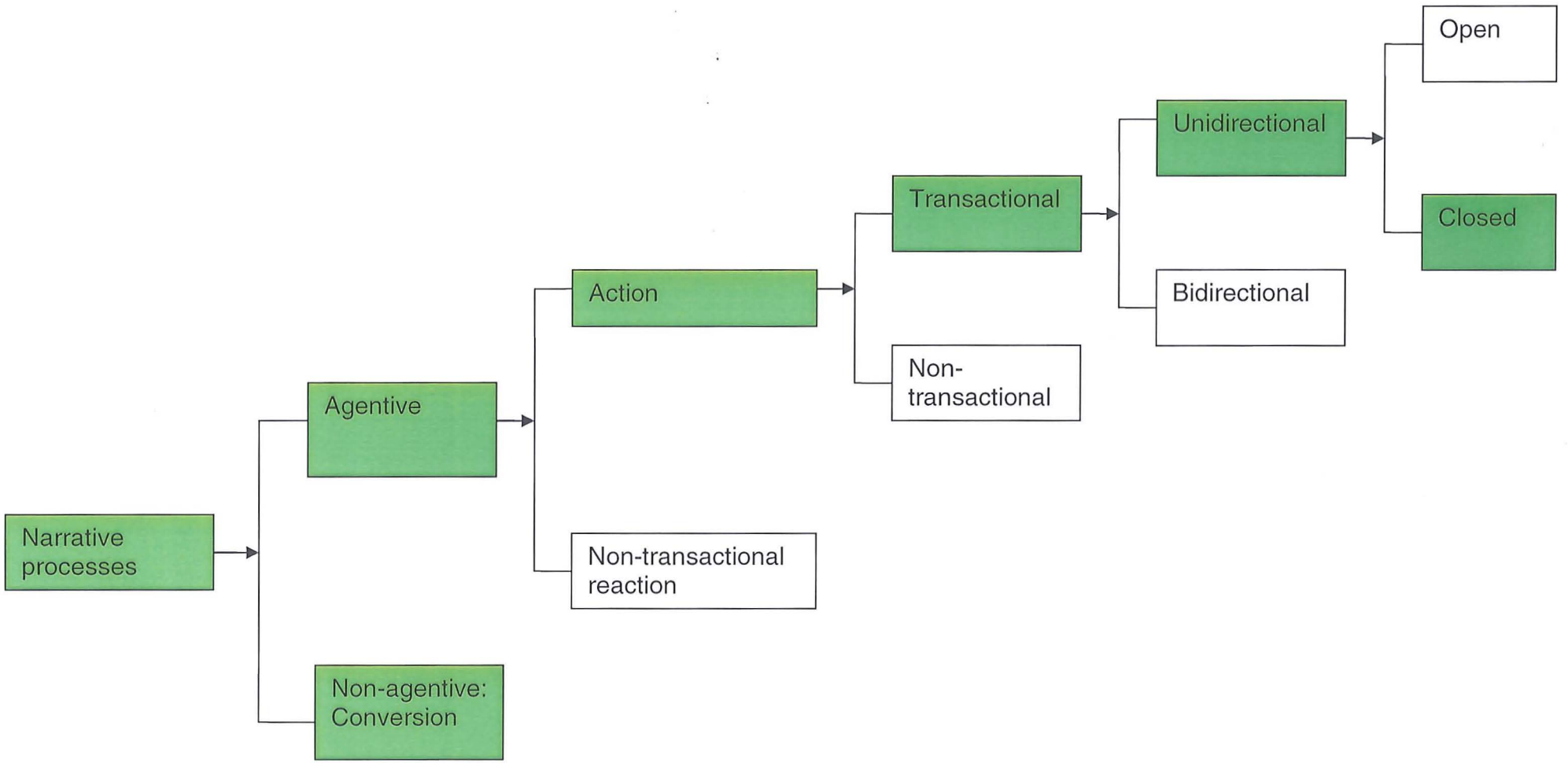

Fig 7.1 Narrative Processes (filtration): students' text

7.2.1 Narrative Processes: students' text

The students' representations of filtration offer two different configurations of the process; one in the visual and actional element of their presentation and one in the verbal.

As has already been discussed in chapters five and six, the students' three dimensional model configures the process of filtration as a unidirectional transaction in which the equipment is the actor and the group of particles (coloured balls) the goal. The elongated shape and prominence given to the equipment by the level of detail and precision in its construction reinforce its role as actor. It also configures filtration as a finite event occurring in a specially designed and defined space. The end product of filtration does not flow away in this representation nor can it keep acting indefinitely. The goal (group of particles) is represented by a finite quantity of coloured balls. Because the representation of filtration is thus physically enclosed and defined it can be moved around without the process being affected. As such it suggests a more stable, universally applicable and arguably more scientific perception of the filtration process.

The students' spoken commentary has been discussed in some detail in chapter five. Like the written worksheet text it configures the narrative process of filtration as a non-agentive conversion with the water as relay undergoing a conversion from goal of the action of filtration. In this commentary the water ceases to exist and is replaced, by the words 'liquid particles' and 'solids'. It is the liquid particles which are actors in the non-transactional process of 'going through'. This verbal commentary represents the part of the filtration process which is absent from the model – the change in state of one of the participants.

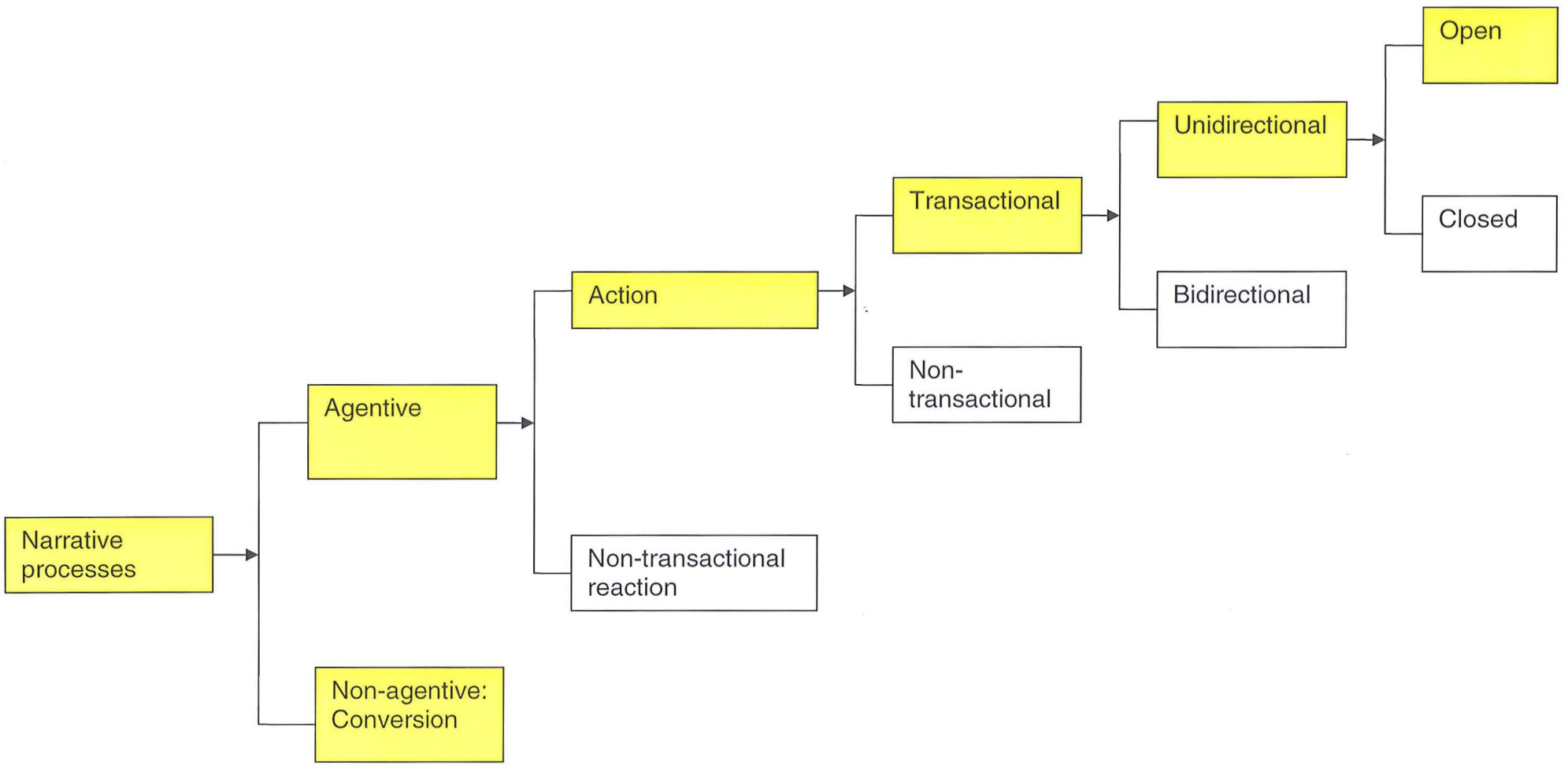

Fig 7.2 Narrative Processes (filtration): resource texts

7.2.2 Narrative Processes: resource texts

The resource texts offer two different kinds of narrative process; one in the multimodal teacher's demonstration and one in the written text (worksheet). That these texts offer such different configurations of the process of filtration is significant and connected to choice of mode; the uniqueness of each mode (speech, writing, gesture) making it more suitable for representing certain kinds of information than others. How modes thus operate together will be discussed in chapter eight.

The teacher's demonstration of filtration has a clearly defined agentive transactional process. Visually the teacher's body is active; he pours water and holds the filter paper cone between his fingers. He is standing in front and to the right of the action (filtration) which takes place over the sink. Apart from carrying out the physical actions the teacher is a participant in the visual composition of the demonstration - he is dominant and his arm creates a vector which extends to the point of the filter paper cone where the goal of the action is located and the transaction takes place. The goal is the mixture and the transaction it undergoes that of being filtered. There is only one direction to the transaction; downwards. Thus the action occurs in a unidirectional vertical movement as the water from the filter paper cone flows into the sink below and does not re-emerge in any form. The whole process, however, is structured visually as something that is ongoing and could continue indefinitely. It does not have a definite beginning and ending; the teacher does not stop filtering because the process itself has finished. In addition the action of filtration is visually located in the setting of the surroundings of the laboratory and the school as a whole. It is not shown in a specially created environment but is integrated into that which already exists. The action process is thus shown as one that is open.

Verbally the teacher's comments reinforce the visual composition of his demonstration. The role of the teacher as actor is emphasized by the use of 'I' and the open nature of the process by his use of the continuous tense and his reference to the location i.e. the sink.

The written account of the process of filtration from the worksheet is, ideationally, a very different proposition and has been described in some detail in chapter six. To summarise, it represents the process of filtration as a non-agentive conversion in

which the mixture is the relay; being both goal and actor in the process. It is acted upon when 'filtered' and active when 'dripping through'.

7.2.3 Narrative Processes: observations

There is considerable conformity observable in the students' configuration of the narrative process. All of the processes evident in the students' texts conform to those that were made available in the resource texts with the exception of one deviation from the resource text configuration. Their three dimensional model is closed. In this regard, as has been noted, it is a more conventionally scientific configuration than that of the teacher. This, then, is not a deviation of an innovative kind but a rectification of the teacher's perceived deviation from the conventions of science. There is further evidence to support this analysis. During the teacher's demonstration a class member, concerned about the unsupported filter paper being held over the sink, asked; 'Sir, why don't you rest it in a beaker?'. Resting the filter paper in a beaker would indeed have reconfigured the teacher's presentation from an 'open' narrative to a 'closed' one and would have made it more formal and scientific. It is likely this student was articulating the feeling of many class members – that the teacher's experiment was not scientific enough. Any implicit attempt by the teacher in his chosen configuration to bridge the gap between the students' everyday experience and the world of science appears to have been resisted in favour of a distinct separation between the two.

Interestingly both resource and student representations of filtration consist of two complementary text types in different modes. In both cases verbal texts represent the process as a non-agentive conversion (the worksheet from the group of resource texts and the verbal commentary from the students' final presentation) while the visual / actional text represents filtration as an agentive transaction. There is clearly an issue with the attribution of agency to the action of filtration and the verbal mode appears better suited to handling this ambiguity than the visual and actional modes. As a response to the multiple configurations offered by the different resource texts, the students' own representation is a rather skilful reproduction of this particular subtlety; the fact that although the effects of filtration on a liquid can be observed, the event itself remains something of a mystery being too small to be visible to the human eye. The students, as is apparent from their commentary and the post-project group interview, were fully aware of the shortcomings of their model in showing the event

of filtration; 'We can't really show it,' they say. There is a mismatch, which the students themselves identify, between what they know and what they show. It would appear they *did* understand more about the process of filtration than could be shown in the model. Without this knowledge they would have believed their model to be an unproblematic, full account of the process. As it is, their response is a sophisticated one and certainly not inconsistent with a more developed understanding, as the teacher may have hoped for, of the process of filtration.

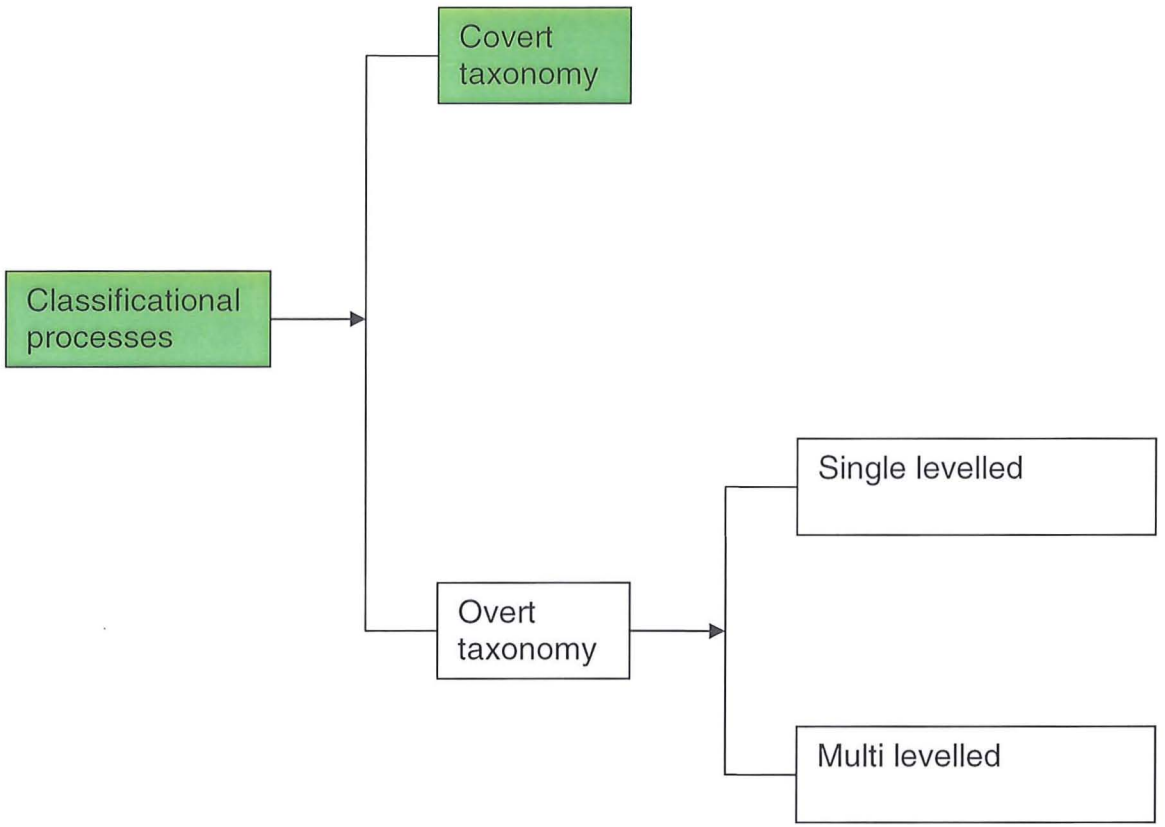

Fig 7.3 Classificational Processes (filtration): students' text

7.2.4 Classificational Processes: students' text

The students' classificational representation of particles is a covert taxonomy of two classificatory groups. The groups are particles behaving as liquid and particles behaving as solids. Equivalence, as has already been discussed, is established through shape and size and difference through colour. The students also choose to use a language structure in their commentary that strongly reinforces equivalence. The sentence consists of two identically structured phrases. This rhythmic uniformity gives added significance to the groupings of words in each phrase: Blue, liquid and water together in the first phrase and red, solid and sand together in the second. Equivalence is also established through the actional mode in conjunction with the verbal. (The gestures referred to below are shown in the presentation text photograph in figure 6.2) On the word 'blue' student C presented a number of blue model particles in her cupped hand. On the word 'red' student D presents an equal number of red model particles in her similarly cupped hand. Their hands are held at the same height and for the same period of time.

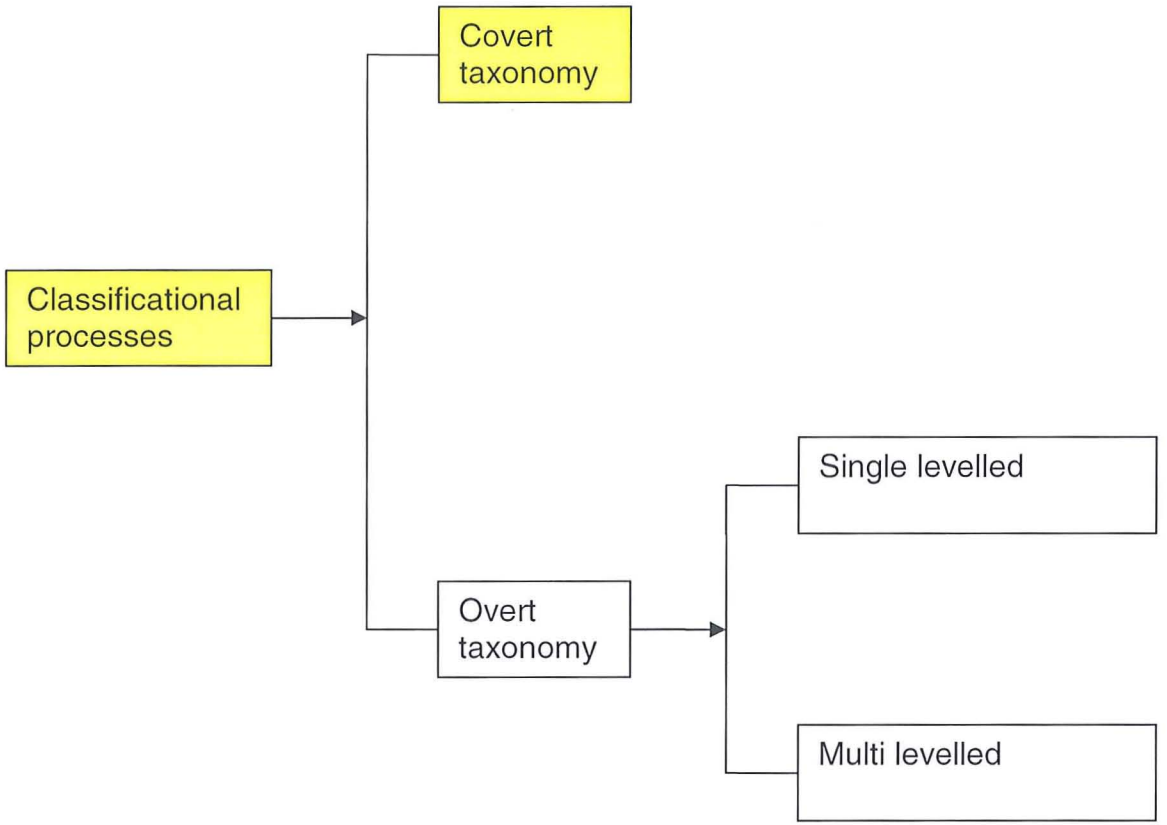

Fig 7.4 Classificational Processes (filtration): resource texts

7.2.5 Classificational Processes: resource texts

The filtration resource texts both offer a covert taxonomy – one in which the abstract concept of a generic particle is invoked but not represented. The visually represented taxonomy consists of two groups of particles – hot ones and colds ones - shown to be equivalent in shape and size. Difference is established, visually, by colour and verbally by the labels.

The sentence structure of the worksheet establishes the idea of a set of two equivalent phenomena through the repeated phrase: 'is called the _____'. This linguistic pattern evokes a taxonomy of substances that can be named and are therefore classifiable. The notion of equivalence is reinforced by the duplication of the linguistic structure the result being that although this written extract makes no direct reference to particles it does offer the concept of equivalence as a representational resource.

7.2.6 Classificational Processes: observations

In this case there is complete conformity between the students' configuration of representational processes and those offered by the resource texts. Both utilise a covert taxonomy with equivalence established through both the verbal and visual modes. There has, however, been an element of innovation in that the students' text includes a classificational process in the actional mode; the gestures described above. This extension of the equivalence of particles in the students' representation is an amplification of the classificational process operating in the resource texts. As such it indicates a strong desire on the part of the students to conform to the received ideological configuration.

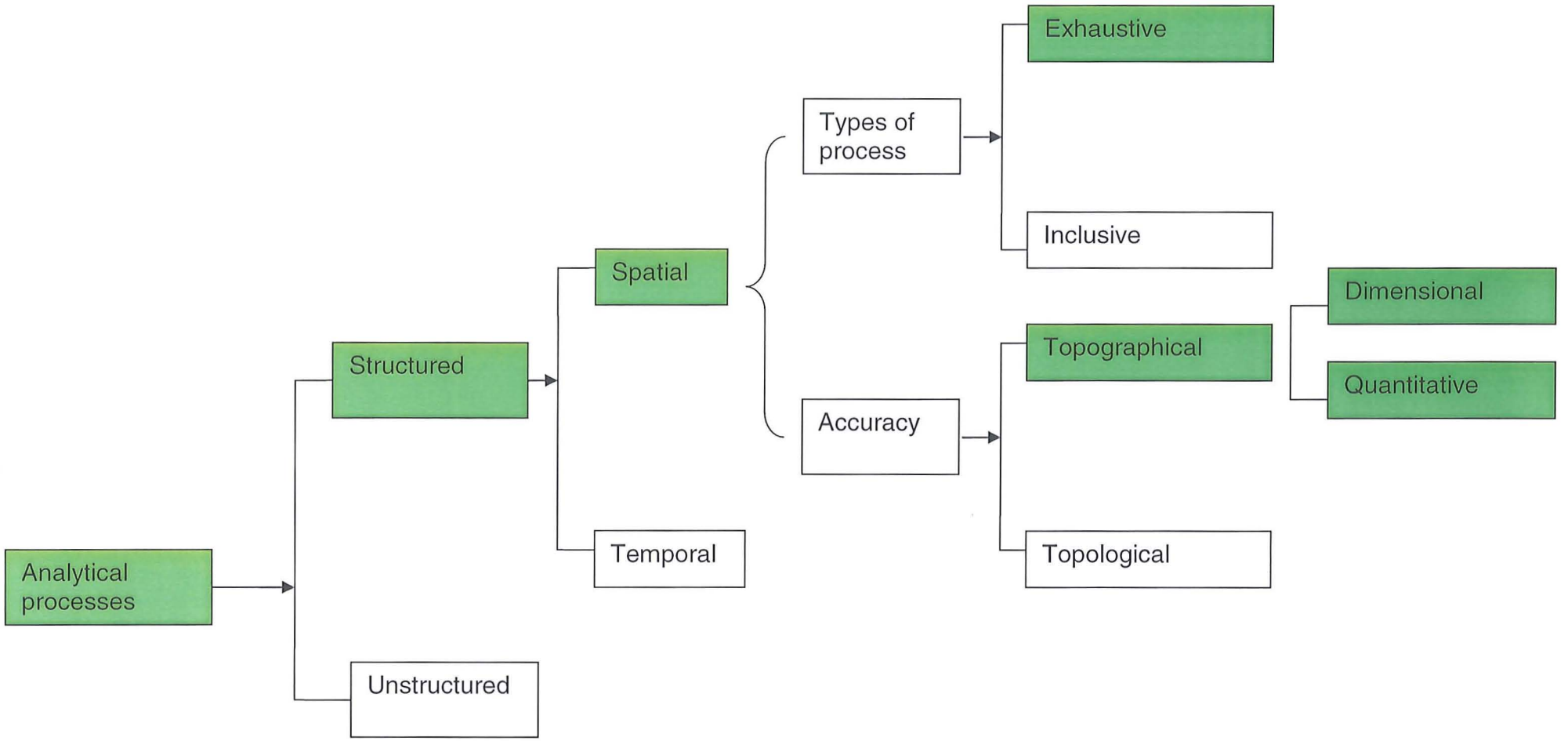

Fig 7.5 Analytical Processes (filtration): students' text

7.2.7 Analytical Processes: students' text

The students' represented particles are classifiable as spatially structured analytical processes. The main possessive attributes are those of being round or circular, of being uneven in shape, and of belonging to a group. The analytical process is also topographical in that the relative dimensions of the particles are accounted for; they are represented as roughly spherical and although each shape is unique the variations in size are regulated – none are significantly smaller or larger than the others. There is also a quantitative element to the analytical process; one model particle represents many. In addition to this, the process can also be identified as exhaustive. The model particles represent the entire group of particles that is to be filtered – not just a part of it. There is no suggestion that there are other particles to be filtered.

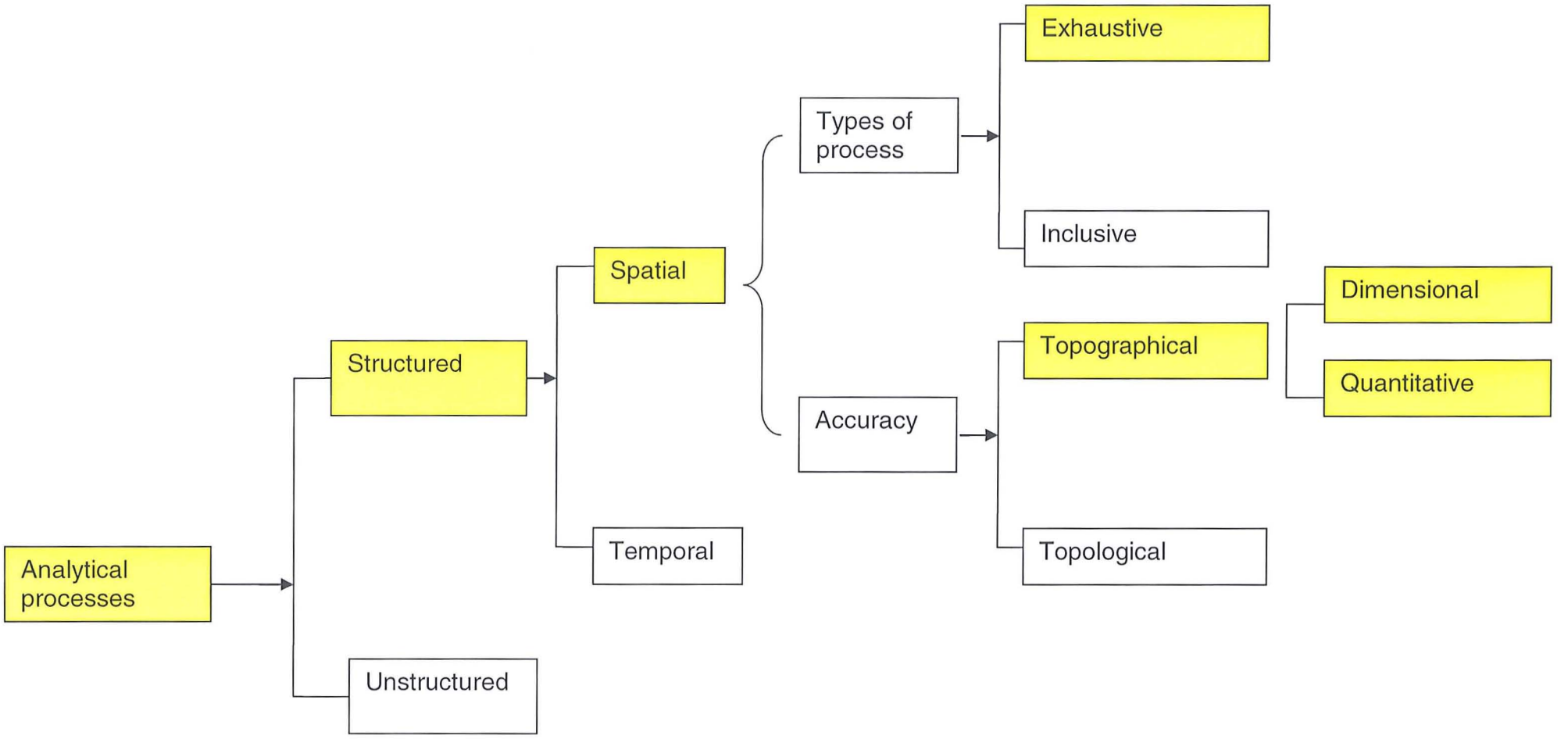

Fig 7.6 Analytical Processes (filtration): resource texts

7.2.8 Analytical Processes: resource texts

The teacher's actional representations and the whiteboard representation of particles are spatially structured. The teacher's actions are concerned with the shape and size of the particles. The whiteboard diagram also represents particles in terms of their shape, the similarity of their dimensions and their spatial relations. Both of these realisations are a form of dimensional topography. The topography is quantitative in that one represented particle stands for many. Further to this, the whiteboard representation of particles is exhaustive in the sense that the particles in the diagram are assembled as a group and are shown to occupy all of the available space – not just some areas of it.

7.2.9 Analytical Processes: observations

With this representational process there is, again, significant consistency between the students' representational choices and those found in the resource texts. In this case the consistency is anticipated given the inter-relatedness of the possessive attributes and the configuration of the representational process. Roundness, size and quantity were offered to students as essential characteristics of particles. That they are criterial is implicit in the whiteboard diagram – an authoritative, conventional science diagram. The importance of these characteristics was also offered explicitly to students by the teacher in his verbal and actional representation (speech and gestures). In their own representation of particles the students replicate the criterial characteristics offered to them. In so doing they produce all the representational configurations found in the resource texts: roundness being made apparent through dimensional topography and size and quantity through quantitative topography. It should be noted, however, that while these configurations were offered through a variety of resource texts, the students combine them in to one. Roundness (represented as a dimensional topography) occurred in the teacher's gesture but not in his verbal representation or the two dimensional whiteboard diagram. Meanwhile the size / quantity relationship (represented as a quantitative topography) occurred only in the whiteboard diagram, not in the gestures and speech. The students' three dimensional model, however, incorporates both the dimensional and quantitative topographies. There is some evidence of their cognisance of the need for this integration. In the dialogue extract concerning the material to be used for the particles (see fig 6.3) student C raises the possibility of using 'little bits of paper'. This

suggestion, however, is dropped in favour of the cotton wool. Had they chosen paper the shape of the particles would have been circular but the roundness of their dimensions would have been absent. This decision consolidated their choice to work in the three dimensional mode making it possible to integrate elements of different resource texts as described above. It is apparent then, that although the analytical configurations of the resource texts and the students' text conform, there has also been significant innovation through the consolidation of a variety of configurations into one single text.

Analytically the students' text embodies all elements of the representational configurations found in the resource texts including that of exhaustiveness. The whiteboard diagram is an exhaustive account of particles in a distillation experiment – all stages of the experiment and areas of the represented equipment are occupied by particles; the whole group of particles is accounted for. It is not a partial (inclusive) representation but, in keeping with the conventions of science (as opposed to everyday phenomena) offers an exhaustive, complete account. That the students' text also represents the particles exhaustively reflects, again the perceived authority of the resource texts.

7.3 Representational Choices in the Benin City Texts

Comparative system networks will be shown for three representational processes occurring in the Benin City texts: classificational processes, analytical processes and symbolic processes. The same arrangement of networks, commentaries and observations used for the filtration texts above is also used here.

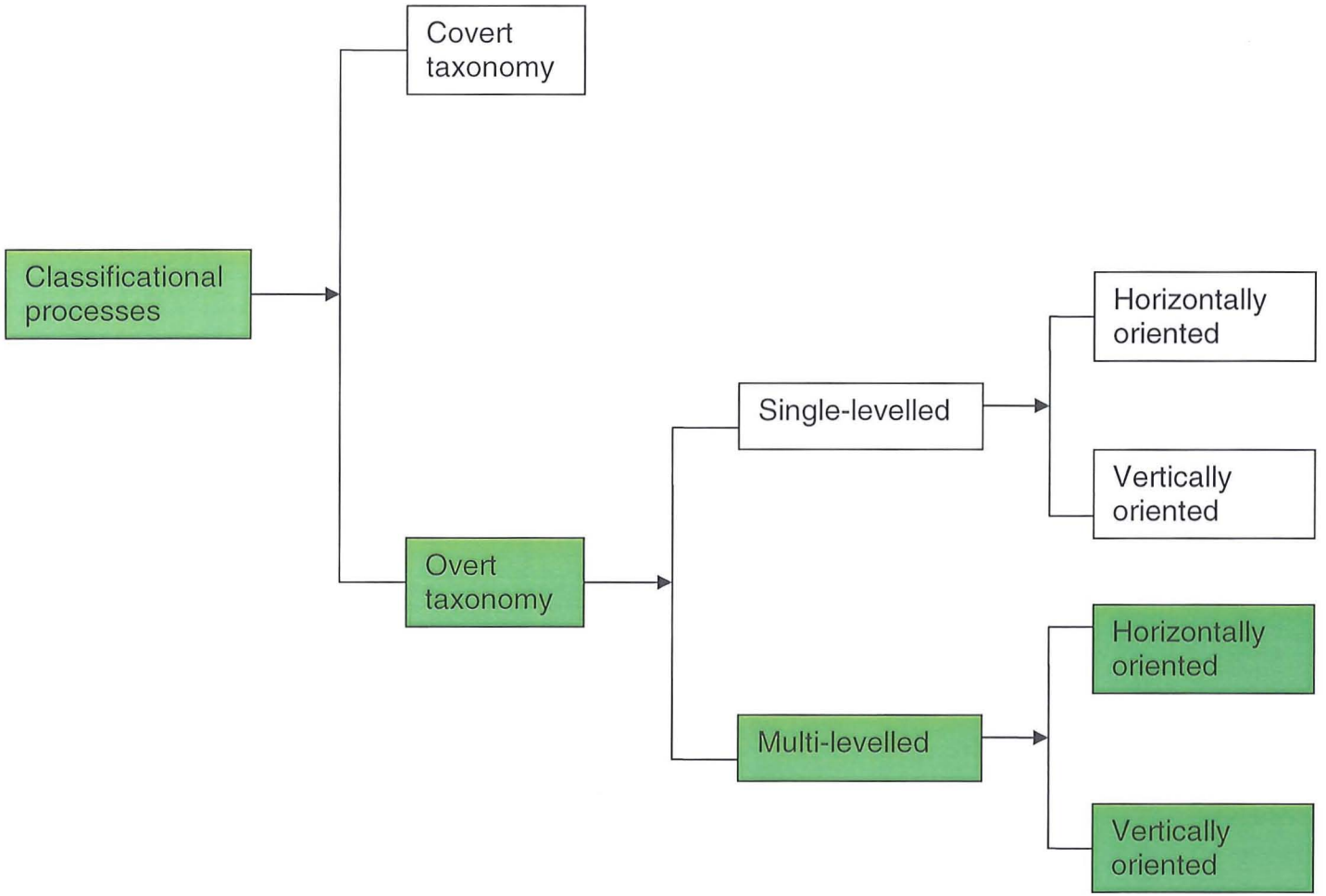

Fig 7.7 Classificational Processes (Benin City): students' text

7.3.1 Classificational Processes: students' text

Classificational processes in the students' text consist of a single multi-levelled overt taxonomy in which the first set of participants (*dwellings*) are vertically oriented and the second set (*trades and crafts*) are horizontally oriented. All dwellings (palace and ordinary people's houses) are shown as equivalent by their shape - rectangular. Subordinate dwellings (ordinary people's houses) are shown as equivalent by their uniform size, colour and position around the vertical axis.

The horizontally oriented taxonomy concerns the trade and craft districts which consist of the ordinary people's dwellings. These three districts are shown as equivalent through their composition (elongated strings of adjoining dwellings), colour (brown dwellings on yellow background) and uniform position (equidistant from roads, water supply and raw materials). The two districts on the right are (spear and pottery makers) subordinate to the one on the left (ivory district) which is twice the size.

In choosing to utilise this particular configuration of the classificational process the students have mentally organised their conception of Benin City in a particular way. The hierarchy of the city is relatively complex and functions at two different levels. First there are the differences between the rich and poor dwellings (the palace and the ordinary people's dwellings), then there is a further hierarchy among the poor dwellings in which one of the districts is represented as more important than the others. These representational structures are well defined and clearly visible not least in the high level of uniformity among the ordinary people's dwellings. In this representation of the city the classificational process is the primary principle of organisation having become apparent at an early stage of representational activity. Its accompanying verbal commentary is an application of the same principle.

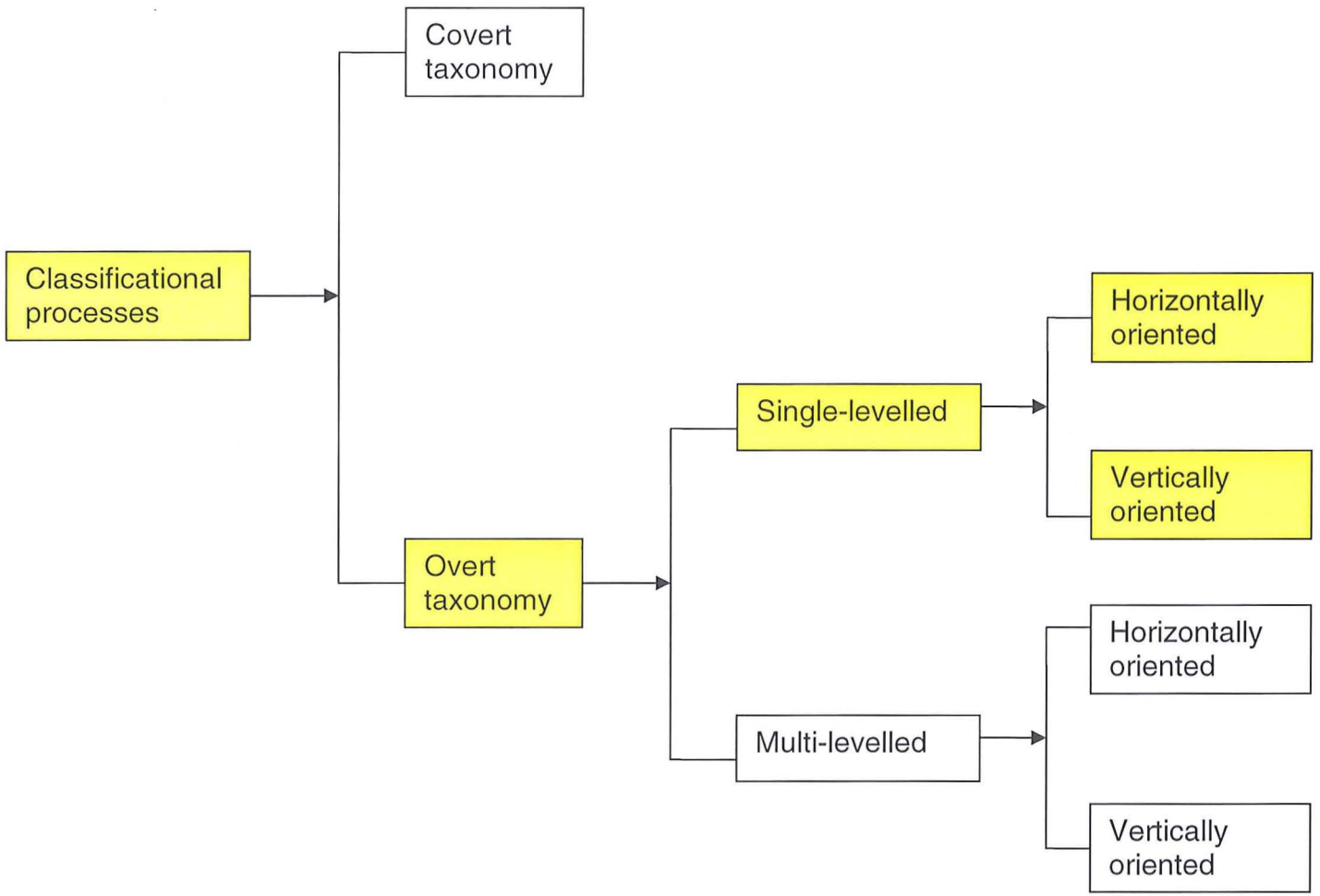

Fig 7.8 Classificational Processes (Benin City): resource texts

7.3.2 Classificational Processes: resource texts

The artefact text picture is a narrative process within which there is a horizontally oriented overt taxonomy of *dwellings* with the superordinate (Oba's palace) occupying a large space on the left. The equivalence of all dwellings (the palace and the ordinary people's dwellings) is marked by their having the same shaped buildings i.e. a principal structure with spire-like projections surrounded by lower, smaller structures. Equivalence between the set of subordinates (ordinary people's dwellings) is established by their uniform shape, spacing, colour and small size.

The second group of resource texts is the set of five cards which deal with the trades and crafts of Benin City. Here there is an overt taxonomy of *trades and crafts*. Equivalence is marked by the colour, size and shape of the images and text. The title card is superordinate in that it is unique among the group and has an overarching function. This card has no visual image, only written text in which it establishes itself as dominant and unifying by referring to generic trades and crafts: 'altogether there were about 50 different trades and crafts ...'.

The overt taxonomy of the chalkboard diagram deals with the classificatory group of rooms or *living spaces*. It has a superordinate larger room at the top with smaller rooms arranged around a vertical axis. Equivalence is established through shape, size and position in relation to the axis.

All visual taxonomies in the resource texts are single levelled. Each resource text (or set of texts) deals with a single classificatory group.

7.3.3 Classificational Processes: observations

It would appear, from the network diagrams, that the students' response to the classificational processes in the resource texts is a matter of conformity. In none of the resource texts, however, does the classificational organisation dominate in quite the way that it is does for the viewer of the students' text. The different single-levelled taxonomies of the resource texts have been combined into one multi-levelled text with two classificatory groups; *dwellings* and *districts*. The result is that the most striking aspect of the students' text is the manner in which the space has been divided between the palace and the districts; the visual classificational process. In consolidating the

various classificational configurations of the resource texts, the students' text has gone much further in foregrounding this particular organisational principle.

The extracts of students' dialogue during their representational activity (fig 6.6) give an insight into how the classificational structure may have come to dominate to such an extent. Faced with the poster sheet on the table in front of them, students had been instructed to represent Benin City. This set of circumstances meant that the city, conceptually and imaginatively, began as the blank sheet. It was a sign in its own right before the students began work. As such their representational task became, less a matter of *creation*, than of *allocation* and *designation*. With the blank sheet signifying the city, every area of it needed to be accounted for and a principle for the allocation of this space needed to be found.

Driven by the need to divide up the area of the city (the physical space on the sheet) students relied on the classifications offered by the various representations in the resource texts. Of these, the chalkboard plan of a house provided a model of a single visual representation organised according to classificational principles. There is a striking similarity between the spatial configuration of this plan and the students' final presentation text. It is into this classification of space that other, less visually apparent taxonomies from the resource texts have been worked in.

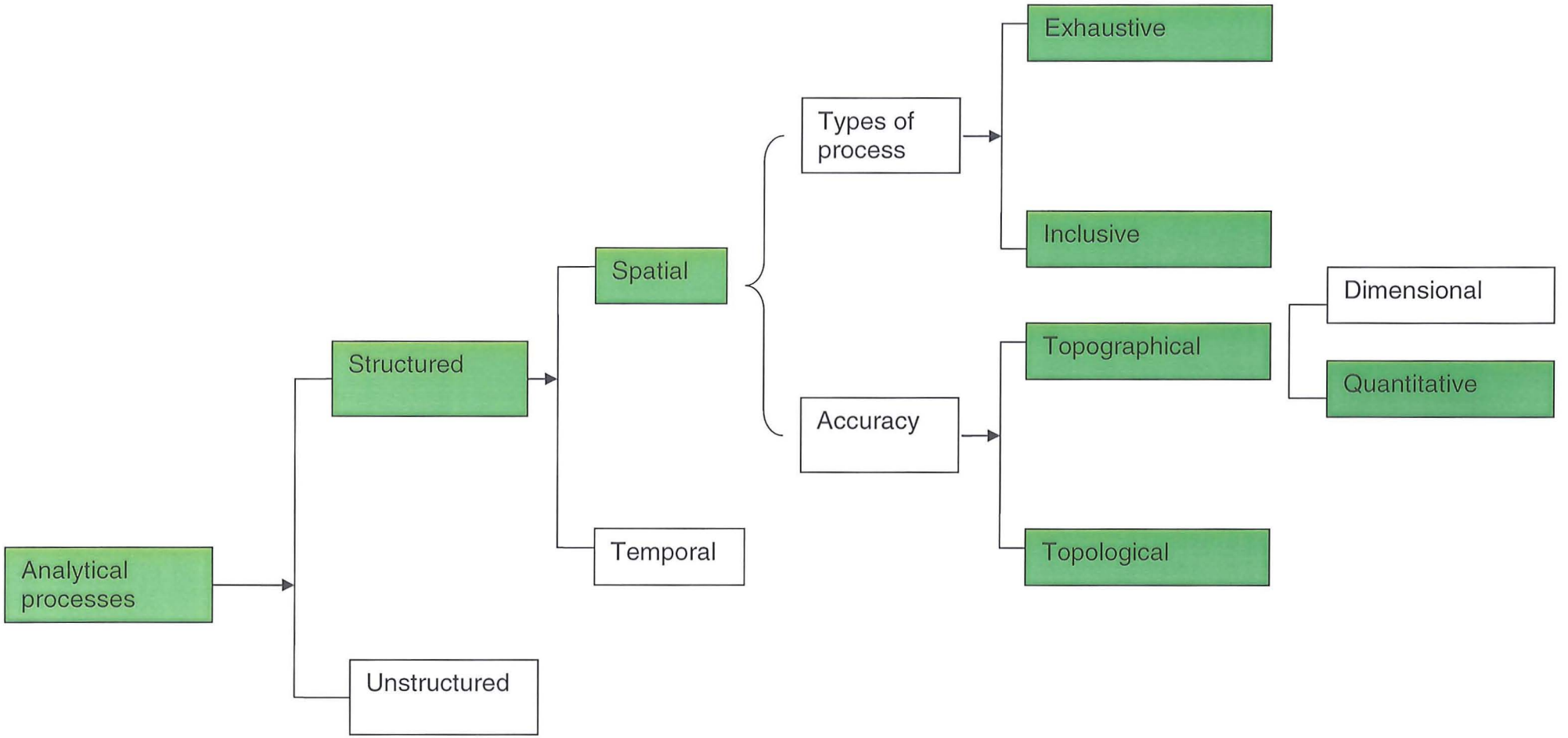

Fig 7.9 Analytical Processes (Benin City): students' text

7.3.4 Analytical Processes: students' text

As a single visual text the students' plan of Benin City works as both an inclusive and as an exhaustive representation. It incorporates the principles of exhaustiveness found in the birds-eye view plan – all space is accounted for. On the other hand only selected features of the city are represented. This inclusive quality echoes that of the written account.

In terms of accuracy the logics of access dominate the students' representation. This has been classed as a topological kind of accuracy for it is based on a consistent logical principle which determines relationships between represented participants. In checking that their representation makes sense the teacher recommends using a pencil or a finger to take an imaginary walk around the city. If the representation makes sense and is topologically accurate, access will be possible where required. This element of the spatial analytical process determines where participants are positioned in relation to others. The water and raw material supplies are positioned close to the relevant districts and the roads are positioned to facilitate access to all areas.

There is also a quantitative principle at work in the students' analytical process. Their drawings of the ordinary people's dwellings embody a quantitative relationship; one represents many. This accuracy is indicated as topographical because it concerns a consistent relationship between a represented participant and its external referent.

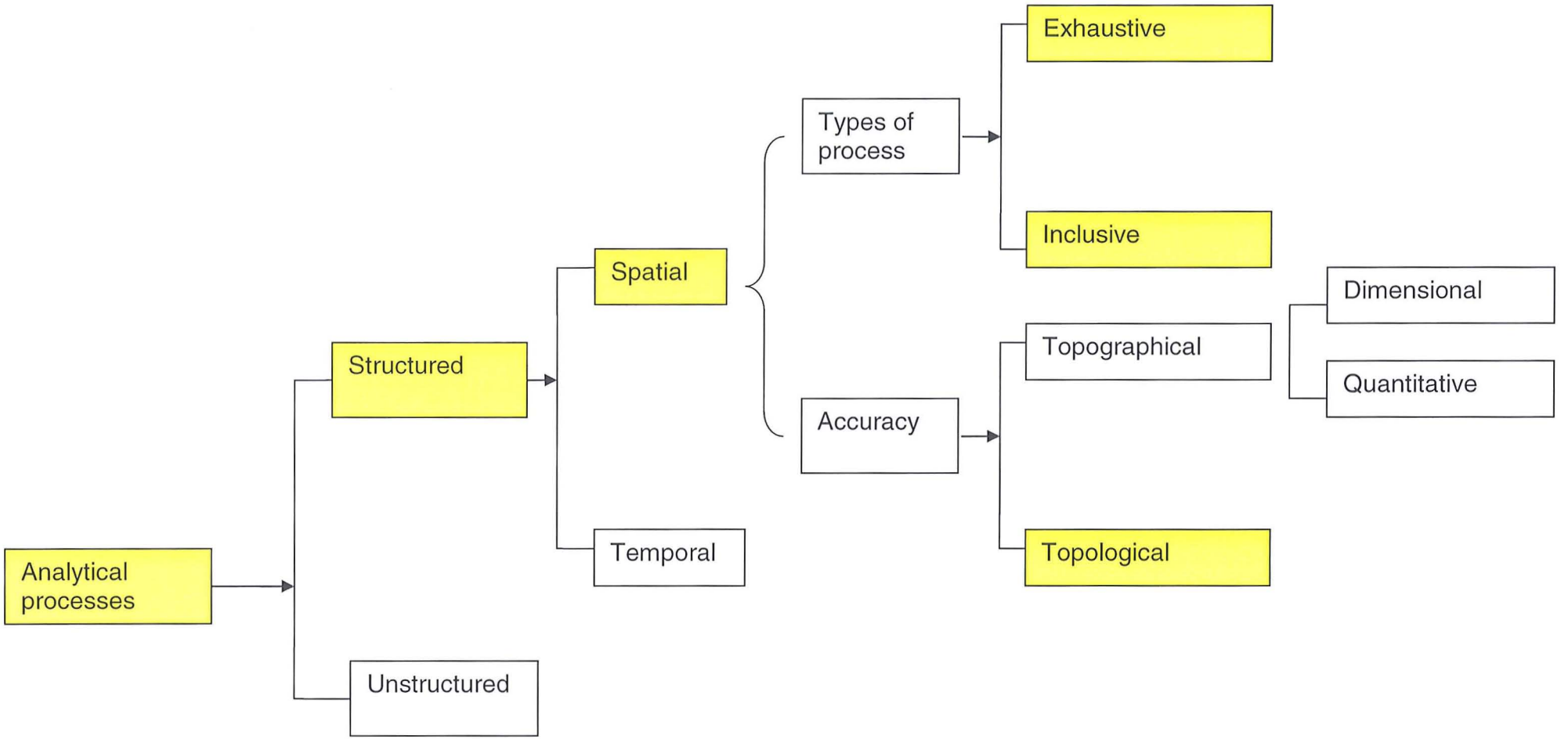

Fig 7.10 Analytical Processes (Benin City): resource texts

7.3.5 Analytical Processes: resource texts

Analytical processes in the resource texts are spatially structured. Included here is the written resource text in which the analytical elements all concern the physical and spatial features of the city.

Both the artefact evidence artist's impression and the written account are inclusive in that they represent particular views of the city and do not claim to represent it in its entirety. In contrast to this, the bird's-eye view chalkboard plan of the house is exhaustive with every space accounted for. The particular combination of these resource texts is problematic for the students. The chalkboard plan creates an association between exhaustiveness and the bird's-eye view. The chalkboard bird's-eye representation, however, is of a single dwelling – a students' house - while the object to be represented by the students is a whole city. Those resource texts which represent Benin City do not do so exhaustively; they (the picture and the written evidence) are representations of selected characteristics only and do not offer a view of the city in its entirety.

In terms of accuracy the visual resource texts offer no dimensional or quantitative topography. The written resource text, however, embodies its own kind of accuracy derived from the logical relation of participants to one another. This bears some resemblance to the principle of topological accuracy in visual representations and is indicated on the network accordingly.

7.3.6 Analytical Processes: observations

It can be seen from the network diagrams that all analytical representational configurations present in the resource texts also occur in the students' text. As has so often been the case, students have consolidated representational resources from a variety of resource texts in to one single text. In addition to this there has been innovation: the use of quantitative topography for the representation of houses is unique to the students' text. This specific configuration enabled the students to show detailed characteristics of the ordinary people's dwellings (information obtained from the resource text diagram of an ordinary person's house) at the same time as representing the dwellings as being large in number (as in the written evidence and the Olfert Dapper picture). This consolidation of elements from different resource

texts is also found where the physical spatial relations between participants in the written text have been integrated with the component parts represented in the visual text. Most significant, however, is the integration of both the inclusive structures of the written and visual texts and the exhaustive structure of the bird's-eye plan.

As has already been noted, the spatial composition of the chalkborad text appears to have exerted significant influence on the students. In spite of this, the analytical configuration of the students' text also operates as an inclusive representation (see 5.4.3). It offers the viewer a representation, not of the entire city, but of selected, relevant features. The conventional text type most likely to be evoked by its appearance is the map – a visual genre that operates inclusively showing selected, relevant landmarks only.

The tension between exclusive and exhaustive configuration in the students' text is evidence of an ideological conflict. During the post project group interview students clearly expressed the view, consistent with the operation of the inclusive process in their representation, that their text does *not* show the whole of the city. In spite of this it appears that the perceived requirement to produce a bird's eye view *plan* (rather than a *map*) was a powerful influence. The source of the plan's influence could be connected with its prominent position on the chalkboard and the length of time given to the demonstration of its production. The students may also have been attracted by a perception of the status of exhaustive representations - as correct, complete and more likely to meet educational requirements.

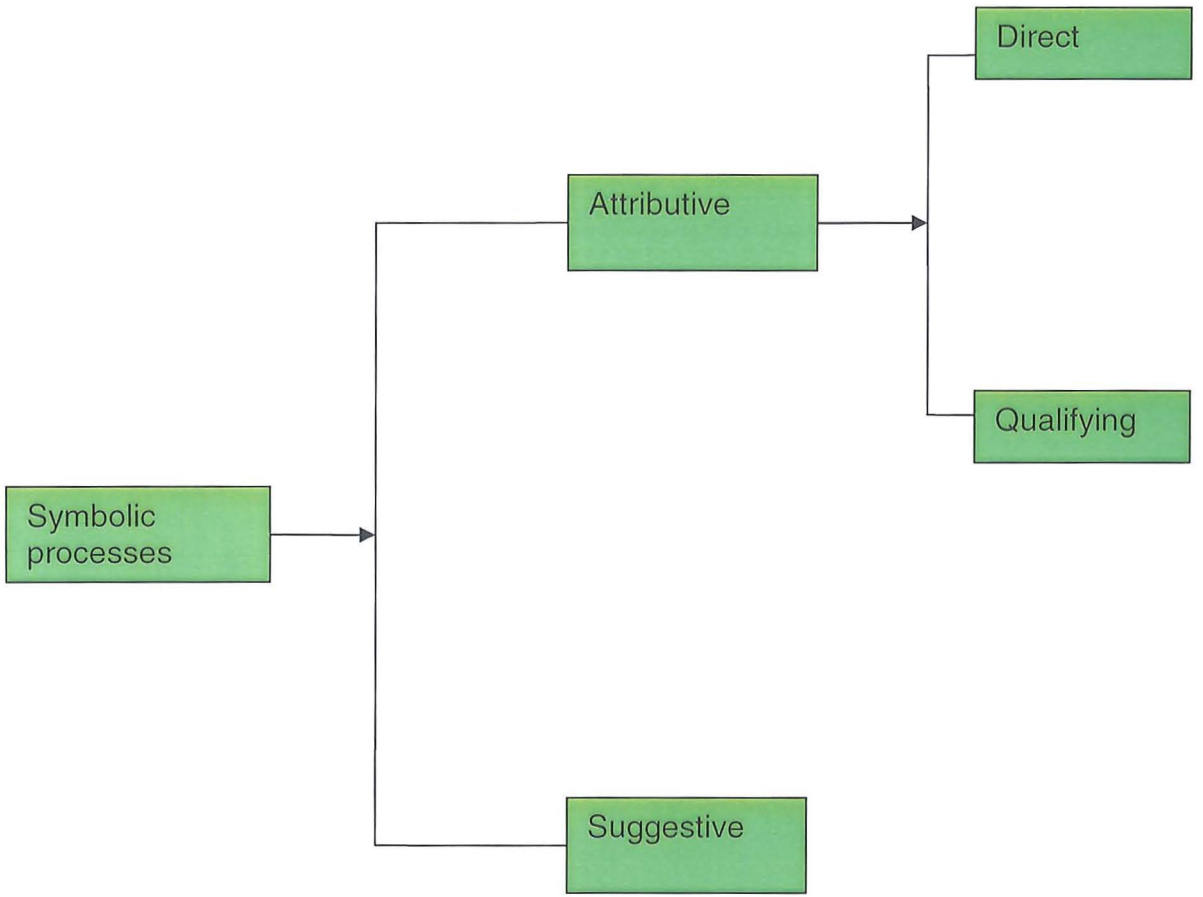

Fig 7.11 Symbolic Processes (Benin City): students' text

7.3.7 Symbolic Processes: students' text

The students' text makes extensive use of symbolic processes of all kinds. In contrast to the analytical process where relatively few possessive attributes are represented (the palace, prison cells, gateways, roads etc), a considerable amount of meaning is carried by the symbolic processes.

Symbolic suggestive processes operate, as has been described, throughout the representation through the use of colour, contrast and shading. Along with the classificational process (see 7.3.1) it is this use of colour which visually dominates the representation. This extensive use of colour is significant for a number of reasons. The symbolism invoked through the use of these colours is well established and conventionalised (blue for water, red and purple for royalty etc). As such it involves conformity and does not require a high level of ideological commitment on the part of the text makers. In short, it is the representational option least likely to invite the challenge of being incorrect. On the other hand, the use of colour is an extremely efficient carrier of meaning – acting symbolically as a kind of short-hand for a wide range of associated meanings. Given the constraints of time and the availability of representational materials, the use of colour symbolism in their representation was an efficient, needs driven choice. That the information load is so heavily supported by the symbolic suggestive can also be partly explained by the relatively limited number of characteristics represented in the resource texts. For example, the absence of possessive attributes in the representation of the Oba's palace is compensated for by the more generalised characteristics embodied symbolically in the sharply defined hyper-real red and purple colours (i.e. royalty, opulence, order, status etc.).

Verbal symbolic attributes are so prolific in the students' representation that it has been necessary to further categorise them into direct and qualifying attributes. As with the symbolic suggestions these attributes confer meaning directly on to carriers. In this case the meanings the verbal symbolic attributes confer are not integral (as with the colours) but external being linked to the carriers by pointers. As such they provide an ideological balance to the symbolic suggestions for they are unique, not conventionalised, and require a high level of commitment on the part of the text maker. Indeed it is due to differing levels in this commitment that the qualifying frames and embellishments are present. In some cases there appears to be a high

level of confidence regarding the information represented as a symbolic attribute. These are the direct verbal symbolic attributes that appear written directly on to their carriers. In other cases there is less certainty, partly because the information is more complex (requires more words) or involves an unfamiliar set of circumstances (e.g. the house without a door). As has been noted, the form of such symbolic attributes bears witness to the students' qualifications concerning the information. In the verbal mode such qualifications are made by hesitating or by using the words 'like' and 'sort of' or uttering 'um' and 'er'.

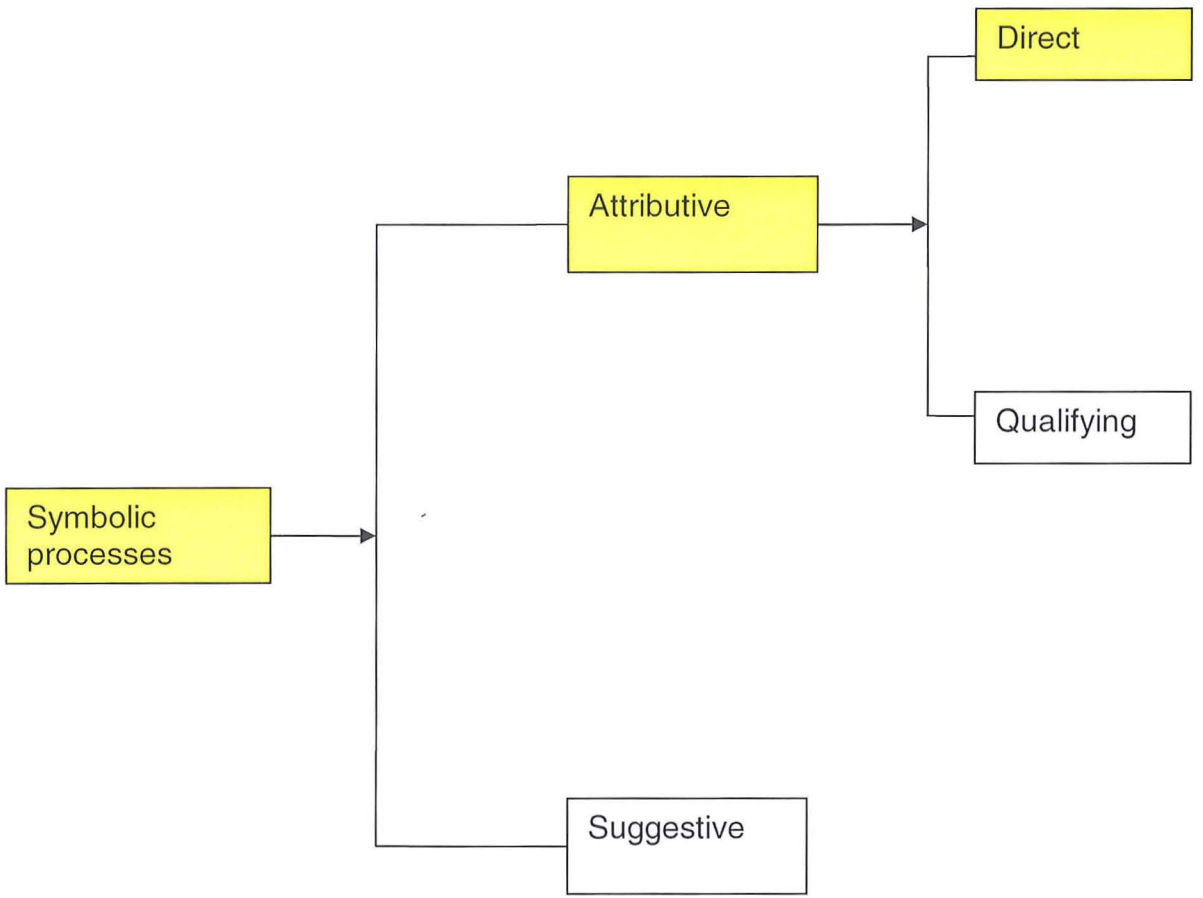

Fig 7.12 Symbolic Processes (Benin City): resource texts

7.3.8 Symbolic Processes: resource texts

The network diagram for the resource texts does not indicate the occurrence of any symbolic suggestive processes. This is not to propose that the visuals concerned (the Olfert Dapper drawing and the illustrations of the crafts and trades) would be devoid of any symbolic suggestion in different contexts of reception. In different cultural settings or at different times in history these visuals may operate (or have operated) symbolically. As resource texts in the current context, however, it is believed that they do not. Most striking is their total absence of colour.

The resource texts feature symbolic attributes extensively. None of these labels, however, have been classified as qualified attributes for none of them bear the kind of decorative, whimsical embellishments found in the students' text. In contrast they appear in uniform typed or handwritten form and are not offered as anything other than certainties of fact. Although positioned beside the carriers to which they refer rather than directly on them, they maintain a directness of association by being linked with arrows.

7.3.9 Symbolic Processes: observations

It is in the configuration of the symbolic processes that the greatest contrast between the resource texts and the students' text can be found. This is largely due to the extensive investment of meaning in the symbolic suggestive processes. The colours of the students' text compared with their absence from the resource texts is particularly striking and reveals a significant shift in meaning load to the symbolic suggestive from the other representational processes. The students' apparent preference for this process could be accounted for in a number of ways. As has been noted above, it requires minimal ideological commitment and has the possibility of invoking a wide range of meanings by drawing on pre-existing cultural associations.

In the case of symbolic processes, it could be argued, the meaning potential of the representation is disproportionate to the knowledge required by the text maker to produce the representation. The appearance of the cross as a de-contextualised symbolic attribute at the entrance to the palace is particularly interesting in this regard. Its appearance in the representation was not, according to the students themselves (see fig 6.11) the outcome of reasoned thought. There is evidence that its

conception originated from the birds with outstretched wings in the Olfert Dapper picture. Given their position on top of the spires and the cultural references of the students it is not surprising that they were read as crosses. The combination of this perception and the references to evil in the tape recorded evidence was powerful enough to evoke a response without any particular basis in knowledge. The symbolic attribute of the cross protecting the palace from evil can best be understood as an affective, culturally shaped response to the resource texts.

Chapter Eight
Mode Mapping

8.1 Introduction

In the previous chapter configurations of representational processes were charted in order to reveal the students' implicit understanding of what was to be represented. In this chapter a similar approach will be employed in examining their choices of representational modes. Here systematic mapping of students' choices of modes and discussion of their subsequent engagement with those modes will be carried out. The intention here is to reveal underlying evidence concerning the students' relationship with that which is to be represented – their *interest* (Kress and van Leeuwen, 1986).

The following analysis, then, is rooted in the belief that the choice of one mode over another is a significant indicator of the text makers' relationship with the object to be represented. Furthermore, it is understood that involvement with a mode through representational work results in certain kinds of mental activity which in turn re-shape the text makers' perceptions. This being the case, a systematic account of the occurrence of different modes in both resource and students' texts should indeed provide further evidence of the process of knowledge making – of learning.

8.2 Operation of Modes

The term *operation* is used here in relation to modes themselves rather than to the text makers who employ them. While it is true that modes are utilised by text makers as resources it is also true that they exert their own forces shaped by the historical and social conventions of their usage. These forces are beyond the control of the individual text maker. As such, modes not only facilitate expression of the text makers' inner meaning and but also contribute, as has been suggested, to the formulation of that meaning.

The relationship between mode, text maker and object to be represented has a number of facets which will be outlined below. Firstly there are the logics of the particular mode. These are fundamental to the mode and concern its inherent orientation towards the world. Secondly there is the materiality of the mode – that which shapes

the physical, sensual experience it can offer. Thirdly there are its affordances. These concern its physical and material requirements and constraints - the suitability and appropriateness of a particular mode for the representation of particular kinds of objects in particular social contexts.

8.2.1 Logics

Inherent in every mode is a particular orientation towards the world – its logics. The logics of a mode are the result of its materiality and thus unavoidable. In terms of logics there are two dominant types: the logic of time and the logic of space. The logics of time govern all sequential, time-based modes such as speech and action. When a mode is bound by the logics of time, simultaneity is impossible and sequence inevitable and unavoidable. The text maker, consequently, is required to conceptualise and organise ideas in sequence. Qualities of change and goal orientation are then necessarily implied as the coherence and unity of multiple parts is overridden by the requirement to order phenomena in sequence.

In contrast to this, the logics of space, which govern the visual modes, require simultaneity. Representation of phenomena using a visual mode necessitates co-ordination of parts; the need to allocate position, for example, requires organisation in terms of status and the relationship of parts to the whole. Thus space based modes promote conception of the world in terms of fixed relationships.

8.2.2 Materiality

The materiality of a mode concerns its potential for physical perception and the semiotic values accorded to those perceptions by societies. The materiality of speech, for example is one of sound and is perceived through hearing. The temporal and invisible materiality of sound is fundamental to the mode of speech and enables it to be used in particular contexts for particular purposes. As such it has the potential to embody a range of auditory qualities such as tone, volume, rhythm and melody - all of which enhance the original meaning in ways which, themselves are socially shaped. In contrast, the materiality of visual representation concerns that which can be seen – light and dark, colour and absence of colour. Although the eyes can detect a range of qualities embodied in a representation, because of the prevalent high status of what can be seen, these variations and differences are more likely to be fully developed

semiotic systems than the differences perceived in sounds. Hence the use of colour and the inscriptional texture of visual representations are here regarded as fully developed modes.

Three dimensional and texture modes can be perceived through the sense of touch as well as that of sight. This makes them particularly suitable for communication situations where there is individual reception. The range of variations in three dimensional positions and texture of represented objects are, like those of sound, less systematised. Weight, smoothness, malleability and other elements of materiality are rarely socially organised as carriers of meaning. They are, however, perceived when touching and handling the represented object and are significant. In this study the impact of the material meaning potentials on the text makers themselves is considered as well as their impact on the recipients of the texts.

As has been noted, the meaning potential of different materialities have been socially organised to different degrees. The meaning potentials of what can be seen have been more highly organised than those of hearing and touching. This being the case, it needs to be noted that the different materialities engage perception with differing levels of conscious mental activity. Where the meaning potentials are most highly organised engagement of the senses is less direct and there are higher levels of mental activity. Where there has been limited articulation and standardisation of meaning the engagement with the senses is more direct and can be said to be affective rather than cognitive.

8.2.3 Affordance

Modal affordance concerns the suitability of a mode as a resource for a particular representational task. This suitability may arise from the requirements of a given social context or from the nature of the object to be represented itself. The affordances of a particular mode are shaped by its logics and its materiality (see above).

Because of specific social and historical shaping, choice of mode is always guided by the immediate context. For example the one to many communication dynamic of the classroom requires the use of modes that afford multiple recipients – modes through

which meaning has the potential to be simultaneously received by more than one person. Speech and action are thus dominant representational modes used by teachers in classrooms. The mode of writing is less prevalent being more suited to social contexts where communication operates at an individual level. In classrooms, because social contexts are replicated on a regular basis, the use of modes as representational resources is conventionalised. Through frequency of usage systems and conventions are established. Because of the social distribution of power in the classroom these conventions are liable to become regulatory. Consequently decisions about the suitability of particular modes for the students' representational purposes (their affordances) are likely to have been shaped to a high degree by the social context.

The affordances of a mode also arise from its logics – the way in which it requires represented phenomena to be organised. There are varying degrees of fitness of purpose between representational modes and the phenomena to be represented. The suitability of time based, as opposed to space based modes, for representing the unfolding of a processes is the most obvious example. Hence the decision by the students in the science project to represent filtration using the mode of action.

The materiality of a mode is a further determinant of its affordances. Given the conventionalisation of its meaning potential and the manner in which it engages the senses, the text maker needs to consider which elements of meaning the mode can most effectively embody. For example, the conventional meanings associated with different colours make this a particularly suitable choice of mode for representing symbolic suggestive processes. An analytical representation, on the other hand, concerns the relation of parts to the whole – an affordance of the visual spatial mode.

8.3 Modes in Use

What follows here is an account of the different modes employed in both the resource and student representations of filtration and Benin City. All texts referred to in the following accounts appear in chapter six where they can be viewed in the tracking semiosis grids to which references are made.

8.3.1 Speech

Among the resources for both science and history speech is one of the principal modes of representation. Texts in the mode of speech include teachers' explanations and instructions in both subject areas as well as the tape recorded oral account of the rise of the empire of Benin in history.

It is worth commenting first on the tape recorded history text for it is speech of an unusual kind. Having been mediated through the technology of tape recording this speech has the unusual quality of being stripped of the mode which usually complements it - action. As the students listened to the recording, huddled around the cassette player in their small groups, they needed to intensively engage one sense only – that of hearing. They could only imagine the facial expressions and gestures of the speaker.

In contrast to the tape recording in history, the speech of the science teacher (already discussed in relation to the co-occurrence of modes) makes an interesting contrast. It was not mediated in any way but was experienced directly in real time by the students. As such the teacher's bodily position in the classroom, his gestures and facial expressions all operate as full modes in conjunction with his speech. This complementarity is particularly marked during the teacher's demonstration of filtration (see fig 6.3). Here the use of words and gestures is simultaneous. When the teacher uses the word 'cloud' for a particle he also makes a rounded gesture with open, cupped hands. In so doing he identifies particular elements of the meaning of the word 'cloud'. Some elements of meaning were thus excluded and some added. The table in figure 8.1 makes a proposal concerning the elements of meaning present in the two simultaneous representations.

	in the sky	distant	large	white or grey	irregularly shaped	not solid	rounded
Verbal mode – spoken word *cloud*							
Actional mode – hand gesture							

Fig 8.1 Orchestration of Modes in Teacher's Representation of 'Particle'

It is apparent that the verbal and actional representations evoke different meaning elements. The word 'cloud' carries a wider range of meaning elements than the gesture. This being the case, the gesture complements the word by making the meaning more specific, focused and precise. It also adds one element of meaning referred to here as the quality of being 'rounded'. This is a possible cloud shape but not usually criterial. Had the word 'cloud' been used alone, without the accompanying gesture its meaning would have been less precise. Had the gesture, likewise, been shown in silence it would have lacked clarity. As an orchestration of modes the representation meets the requirements of the text producer – to represent the characteristics of particles which in this context were deemed criterial.

The students themselves use speech extensively to facilitate collaboration in their representational work. The spoken extracts are evidence of a considerable amount of conceptual sign making realised only in the verbal mode. In science, for example the students describe a two dimensional model in speech (fig 6.5). It is apparent from student B's words that she has an idea in her mind – an imaginary representation of filtration. In history the students speak of a throne and secret passageways (fig 6.9) neither of which appear in the presentation text although they exist as part of the students' imaginative experience of Benin City. The speech mode thus plays an important role in mediating representation in the more permanent (space based as opposed to time based) visual modes.

8.3.2 Writing

In science the students were provided with a single written text – a worksheet (Appendix i). This concerns not just filtration but all the processes of mixture

separation to be learnt by the students. The sheet consists of a word search puzzle and a gap fill exercise – nine partially complete sentences with the words to be inserted provided in a separate box. Once completed by the students, the single sentence serves as written account of the process of filtration – the only representation of the process in the written mode available to students (fig 6.2).

In the students' three dimensional representation of filtration the written mode is limited. The only writing present on the filtration model is the label around the neck of the flask. This has two functions; to identify the process it represents by providing the title 'Filteration' and to establish authorship - the word 'by' preceding the names and class of the four students in the group. The function of the written mode, then, in the students' three dimensional model is interpersonal, not part of the narrative representation of the process of filtration itself.

In history the written mode was more prominent. In the teacher's introduction to the project one of the four groups into which students were organised to study resource texts was the 'written historians' group. These written resources consisted of two extracts from historical accounts of visits to the city; one of two paragraphs and one of one. In addition there was extensive use of written captions and labels on the so-called artefact and archaeological resource texts. In all these written texts the different means of transcription operate as complementary visual modes to the written text. Among these, three different kinds of transcription are identifiable: typed quotations, typed captions and handwritten labels. The written resource texts are imported from other contexts and include the two visitor's descriptions (transcriptions of historical documents) and the text book photocopied account of carbon dating. These written texts originate in contexts beyond the school classroom and utilise forms of transcription associated with mass distribution. They are, as such, the most authoritative forms of writing and give a particular status to the historical evidence – that of secondary sources which have already been used by historians.

In contrast to the mass distribution transcription of the written resource texts, the hand written labels and captions suggest that the historical evidence to which they refer is a fresh find, not yet processed, and open to new analysis. The hand writing is also more personalised, less authoritative and configures a more equal interpersonal relationship

with the recipients of the text. The drawing of the house in 16th century Benin, for example, has a hand written caption (fig 6.10) and elicits an interesting interpretation from the students. They conclude that the occupants of the house must have used windows for access on the grounds that this is the only possible entrance visible in the picture. This response is entirely consistent with the requirements of the task – to act as real historians by drawing conclusions from close analysis of the sources. In contrast, resource texts with typed captions (for example the title card for the trade districts - 'Works of Art and Artefacts' in figure 6.6) elicit a more conventional response rather than an imaginative interpretation.

During their representational activity, the students' written notes play a significant role (Appendices ii and iii) because the original resource texts are no longer available to them. The teacher, however, instructs the students to produce a visual representation and it quickly becomes apparent that the information the students have in their written notes needs to be transducted to a visual mode. The following extract of students' dialogue is taken from the end of a lesson spent working on their representation of Benin City:

D *We need to add more drawings.*

B *Look, that's the whole point, it's supposed to be a plan of the city. It's not supposed to be a description.*

Student D is reflecting on the amount of physical space on the sheet of paper. Student B identifies this as a need to invest more meaning in the visual mode and to move away from thinking in terms of written descriptions. In this endeavour the students succeed for the final representation is indeed a visual text with the written mode limited to symbolic attributes of visually represented participants.

In contrast to the predominantly visual representation of the focus group, other groups of students retained information in the written mode. The following Benin City plan produced by a group from the same class has a paragraph of written text stuck on to the visual representation. This writing is not an integral part of the plan but has been imported and physically attached to it. It is possible that this group of students, having been unable to show certain pieces of information visually, decided to add the

written text to augment the meaning of the representation as a whole and so gain higher marks for including more information.

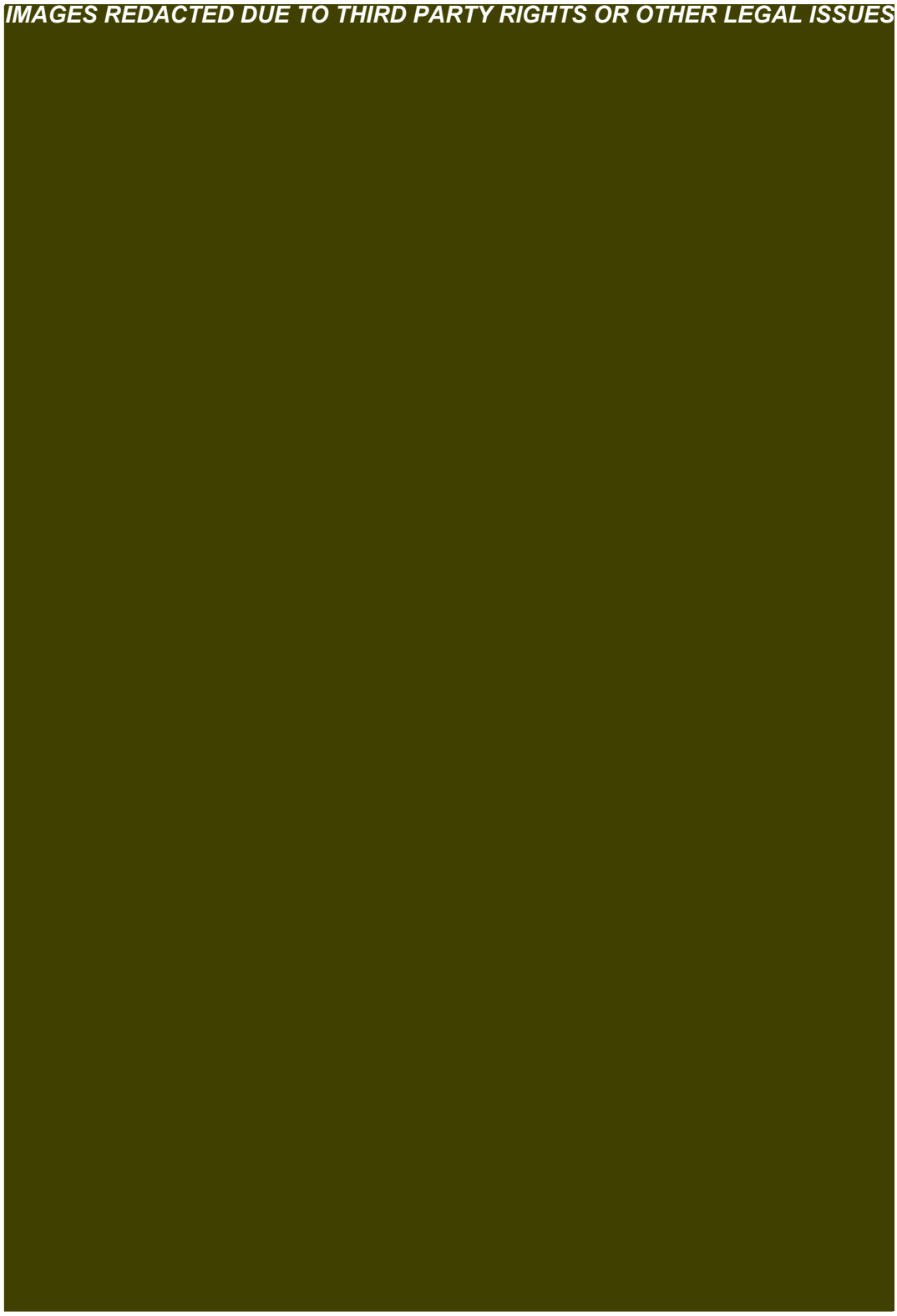

Fig 8.2 Plan of Benin City With Written Text Attached

The focus group of this study chose not to employ this method but to attempt to convey all their information visually – a decision which led to a number of representational challenges.

8.3.3 Visual-spatial

Where there is visual assembly the visual-spatial mode is in operation - the position of represented participants in relation to one another is meaningful. Every visual representation – whether in two or three dimensions requires the producer of the text to make decisions regarding place and position. The meanings inherent in particular spatial arrangements are conventionalised and can be accounted for in a systematic way. The conventions applied here will be those put forward by Kress and van Leeuwen (1996) and concern position around the horizontal and vertical axes, centring, framing and salience arising from other features such as size, foregrounding or overlapping.

Having chosen the three dimensional mode to represent filtration – rather than that of a two dimensional drawing – the students were able to represent filtration as fully as they required. This choice of mode was a reasoned one and discussed by the group for around fifteen minutes. The following fragments of discussion give an indication of the considerations and issues leading to the decision to work in three dimensions:

C *Filtration, we could draw that on a poster.*

D *No, but you have to show it.*

Student D immediately dismisses the two dimensional drawing option – it does not meet her requirements of 'showing' which are, as yet, unarticulated.

A *We're going to have to get real filter paper.*

D *If you do it's going to get wet.*

C *If it's going to be made out of paper you can't even see through it.*

Here the students start to distinguish between doing filtration in real life and making a model. The first problem that arises is that the paper will get wet if real water is used.

The model would then disintegrate. As a representation, student D understands that it needs to be more permanent.

The problem identified by student C is quite different. For her the purpose of the model is to enable filtration to be seen and paper would hide the process. The students are thus moving towards a set of criteria for their choice of mode: it needs to afford some permanence *and* facilitate viewing.

D *No one is going to be able to see nothing if you draw it.*

B *Make a model.*

Student D, now working with the criteria of visibility, dismisses the two dimensional visual mode. Although the precise reasons why filtration would not be visible in a drawing are not articulated verbally, student B is aware that the three dimensional mode (the model) will show more.

B *We just like pretend pouring it in.*

Here student B is developing her understanding of the representational possibilities afforded by the three dimensional mode. She raises the possibility of using the model as part of a bodily enactment. As such it would be possible to create a time-based representation in which change could be shown. She also introduces the idea of pretence making an important distinction between filtration of a real mixture and a *representation* of the event.

To summarise, these extracts reveal the students' strong desire to show the process of filtration visually. A two dimensional drawing would not be able to show the goings on inside the filter paper, nor would it have been able to show the unfolding of events. Not all students in the class chose to work in three dimensional modes as can be seen in figures 8.3 and 8.4. Those who chose to work in two dimensions used the written mode to account for the different stages of the process. The focus groups' model, however, with its transparent material and potential for manipulation enables the students to display the internal workings of filtration as an unfolding event.

Fig 8.3 Two Dimensional Visual Representation of Distillation Incorporating Written Account of Process

Fig 8.4 Enlargement of Written Text From Two Dimensional Representation of Distillation Process

The bodily arrangement of the students during their presentation also employs the visual spatial mode and conforms to the composition of a horizontally oriented triptych. There is a transition from *given* to *new* via a centrally positioned *mediator* – in this case the filtration model which is placed on the table in front of the centre of the group (fig 6. 2). The account of the process begins with the students to the left of the group and ends with the student on the right. This composition is a conventionalised representation of mediation from given to new with the centre position being occupied by the mediator. In this case the mediation operates from left to right (the conventional *given* and *new*) from the presenters' perspective, not the viewers'. As far as the audience is concerned the presentation appears in reverse with directionality from right to left. From the students' point of view, however, it is consistent with the visual convention common to western European cultures.

The model itself follows the top to bottom horizontal orientation required by the law of gravity acting on a liquid. The junction of the filter paper at the neck of the flask is, however, made salient by being covered with the written label. This is where the word 'filteration' appears and is precisely where the filtration happens.

In the students' presentation the model itself is clearly positioned in the centre as the mediator. In the teacher's demonstration the absence of equipment (filter funnel and flask) results in the teacher himself acting as mediator in the spatial arrangement. This demonstration also differs from the students' presentation in that it is vertically oriented with the mixture being poured from the top and the filtrate pouring away down the sink. The conventional values associated with vertical mediation are *ideal* at the top and *real* at the bottom. The teacher's choice to visually compose his demonstration in such a way that the *bottom* space is occupied by the sink (an everyday, rather than scientific entity) gives a particular quality to the *real* element of the composition. This visual linking of the scientific *real* with that which is commonplace and in everyday usage contributes to the general demystification of the filtration process as discussed earlier in relation to the teacher's presentation as a configuration of the narrative process.

In the students' plan of Benin City the visual-spatial mode also operates extensively. Most obviously there is the position of the Oba's palace at the top of the page in the *ideal* position with the ordinary people's dwellings below in the space for that which is *real.* Not surprisingly there is little variation on this spatial arrangement among the representations from other groups. Only one group from the same class positioned the palace in the lower right hand corner in response to the written evidence. The focus group started with the palace in this position in the rough sketch (fig 6.6) but moved it to the top of the page for their final presentation text. A further consideration with regard to the visual-spatial mode in this final composition is the extent to which the cross – symbolising protection from evil – operates as mediator given its central position in the composition.

Framing, through discontinuity of colour and material, operates in the Benin City plan to connect and disconnect elements of the composition. The palace with its ultra-real colour and sharp outline is discontinuous with its surroundings. The ordinary

people's dwellings, however, are continuous in relation to one another – they share boundaries, and have similar colour quality to the natural elements around them – the ground, forest and roads. Salience is given to the elements of the composition made to stand out because of the density of their colour (marker pen). In addition to the palace, the elephant herd, ditches and lake are also made salient in this way. The salience of these particular three features of the composition can be accounted for by another characteristic they have in common – their potential danger to the population.

Among the visual resource texts the artefact evidence book illustration is horizontally oriented and the chalkboard plan is vertically oriented (fig 6.6). In the drawing the palace occupies the information value position of *given* on the left while what appears to be the rest of the city is on the right. In this case the Oba's procession is given salience in the foreground and the Oba himself occupies the central position – in terms of the composition, the position of mediator. This prominence accorded to the Oba is completely absent from any of the students' representations in which there were no representations of people.

In contrast to the book illustration which is horizontally oriented giving salience to the population in the foreground, the chalkboard plan is vertically oriented and includes no representation of human occupants. In this case the largest space occupies the position at the top of the composition. Central positions of mediation are occupied by doors and points of access.

8.3.4 Visual-shape

Closely connected to the operation of the visual-spatial mode, visual-shape also functions as a mode in its own right in the two and three dimensional representations.

In the process of the science project the diagram of filtration equipment in the students' textbook (fig 6.5) was accorded particular status by the students (see 6.2). Shape being the dominant mode of this representation, it is this quality that the students work particularly hard to replicate. The position of the diagram in the textbook, the salience afforded by the labelling contribute to their perception that achieving the right shape will, in itself lead to the occurrence of science. This preoccupation with shape is not unique to the focus group working on filtration. In

the two dimensional representation of distillation it is the equipment and the shape it assumes when correctly assembled that is the most salient element of the composition (fig 8.3). Because it is a cross-section of the experiment equipment there is no perspective – just a thick black outline of the shapes of the flask, Leibig condenser, tube and beaker. The shapes produced by these outlines are themselves signifiers. The neck of the flask opens out at the top, its body is bulbous and the beaker has a curved lip. These shapes are not part of the narrative representation of the process of filtration but confer, through conventional associations, scientific identity on the representation. A similar process is at work in the three dimensional model produced by the focus group where it has been noted how accurately the students desired to replicate the precise shapes of the filter funnel and flask. In spite of this desire to replicate the conventional shape, what the students finally produce is their own interpretation of that shape. As such they have gone beyond replication of conventional visual signifiers to utilise shape as a representational resource. Their model flask is an elongated version of the referent with a much greater distance between the top and bottom; the before and after of the filtration process. As such, the shape of the model foregrounds change and the difference in state between the liquid before and after filtration.

In the students' representation of Benin City there are two categories of shapes – geometric for man made objects and organic, irregular shapes for naturally occurring features. Hence all constructions (including the roads) can be distinguished by their regular shapes and straight lines, often drawn with the aid of a ruler. The forest, ditches, lake and river, in contrast, have natural, irregular shapes and are drawn by hand. To this extent the students employ shape as a form of visual lexis; a ready made set of visual signifiers. In addition to this, however, there is evidence, as in the science model, of shape being used as a more fully developed representational resource – a mode. There are a number of instances where shape is used to represent the inter-relationship between man and the natural world by visually marking specific points of juncture between the two. The elephant herd enclosure, for example, is a circle and therefore belongs to that set of shapes with which the natural world is associated. It also, however, embodies regularity which contrasts with the random shapes of the lake and ditches. Another example of the juncture of nature and man represented through the mode of shape occurs at the edges of the forest on either side

of the lower part of the plan. The shapes within the forest are highly irregular and heavily textured (see fig 5.5) yet the blocks of forest on either side of the plan appear as rectangles – shapes associated with man made order. This reading of the representation of the forest endows the junction of the straightened edge of the forest and the yellow earth of the city itself with a particular quality. It serves to represent the edge of the forest as the point at which human dominance meets nature. The move from one to the other is not seamless – the boundaries of the shapes represent fissure and the city of Benin is, represented, fundamentally, an area of cleared forest. The possibility of the forest encroaching on this part of the city (the forest borders only the ordinary people's section, not the palace) is not ruled out.

8.3.5 Colour

In the filtration texts colour as a mode represents a single, precise meaning and does so according to well established, scientific convention. The meaning it represents is the difference between two groups of particles. In the resource text the two different particle groups are hot and cold, in the students' text solid and liquid. The colours used are, however, the same – red and blue.

There is one other visual representation among the resource texts which, it could be argued, uses the mode of colour. This is the textbook diagram (fig 6.5) in which the absence of colour establishes its de-contextualised, non-realistic and therefore universally applicable quality. The same representation does, however, include a single variant in density of shading (a paler, grey outline) to indicate the pieces of equipment that have been imaginatively disassembled.

The absence of colour from the students' filtration model is partly accounted for by their choice to work in three dimensions rather than two. As such they were able to utilise transparent, colourless materials to replicate the appearance of the equipment in the textbook diagram. They succeeded, with some difficulty, in finding suitable materials: a sheet of clear Perspex and an empty plastic water bottle.

Other groups of students who chose to work in two dimensions were obliged, in a way that the focus group was not, to colour more extensively. In the two dimensional representation of distillation (fig 8.3) the purple background serves to distinguish

between the experiment itself and other areas of the representation and to make the process itself more salient. While using the conventional red and blue for the hot and cold particles (and their own green for normal temperature particles), this group also used additional colours to identify the presence or absence of items inside the equipment. Orange is used for the liquid, white for gas and light brown for the funnel inside the neck of the flask. Aesthetically this representation is a much more colourful and visually attractive proposition than either the resource texts or the focus group's three dimensional model. As such it does not make the same claim to be real science as the three dimensional model which does not require such definition being movable and so readily distinguishable from its surroundings.

Patterns of occurrence of the colour mode in the Benin City texts have already been commented on in relation to their usage in symbolic suggestive representational processes. The absence of colour in the resource texts, it has been noted, is particularly striking. This can, in part, be accounted for by the restrictions of the reproductive technology - all the visual texts had been photocopied in black and white. They had, however, been mounted on to colour coded cards – red for written evidence, blue for artefact evidence and yellow for archaeological evidence. This regulated use of colour by the teacher reinforces the underlying principle of doing history as asserted by the teacher in her verbal instructions to the class - the need to be able to support one's assertions with reasoned evidence.

As a two dimensional text, the students' representation of Benin City is particularly suited to employing the mode of colour. The supply of colouring equipment – marker pens, crayons and coloured card – was, however, under the control of the teacher. Although a wide range of colouring tools were made available for the production of the final presentation text there were, interestingly, none available at the note-making stage of the activity. Consequently none of the students' notes or sketches include any colour or any written references to colour. As has already been noted, the representation of Benin City was largely a transduction of meaning from resources using one set of modes to a textual form utilising a different set of modes. That colour was readily available and such a dominant mode in the students' representation would imply that a considerable quantity of meaning invested in other modes in the resource texts must have been transducted.

8.3.6 Texture

Texture is one of the less conventionalised modes under discussion here. In this case it is understood to refer to the quality of the surface of representations. Texture is the result of the choice of material and method of inscription. It operates as a carrier of meaning, although with different potentialities, in both two dimensional visual texts and three dimensional texts. In two dimensional texts texture is only perceived visually. In three dimensional texts it is also tactile.

Texture was a particularly important mode for the students in the making of their model of filtration. In constructing the flask and funnel students were extremely concerned about finding the right kind of material. The texture of the plastic material they finally chose was smooth and glass-like – as close as they could get to the real thing. They also gave priority and discussion time to the material used to create the model particles. They chose, as has been discussed, balls of cotton wool dipped in paint which provided a satisfyingly irregular (and therefore natural) and manageable texture. The experience of working with both these materials was central to the students' representational activity. They spent considerable time working out what would be best to use: 'It took us like a whole lesson to figure out what materials to use,' said student B in the post project interview. The phrase 'figure out' indicates that this was not simply a matter of aesthetic choice or taste but a systematic consideration of the representational criteria and how they could best be met.

Texture in two dimensions differs from texture in three dimensions in that it is a uniquely visual rather than a visual and tactile mode. The texture of three dimensional objects can be felt as they are touched and handled. With a two dimensional text, as is the students' Benin City plan, texture still features but can not be perceived as tactile. In this case texture is determined by the choice of inscription material (marker pen, colouring pencil, paint, ball point etc) and the manner in which it is applied to the surface. The operation of texture in the students' Benin City text has already been discussed in relation to its symbolic suggestive processes. It operates extensively – every area of the plan having been covered with a textured application of colour. Although the mode of texture is realised in the application of colour it operates within its own set of regulated meanings. Less conventionalised

than the symbolic meanings of other modes (for example colour), and therefore more open to individual interpretation, the meanings evoked by particular types of texture are nevertheless a significant component of the modally orchestrated meaning potential. The sight of the intensely saturated and consistent colour of the Oba's palace and the knowledge of the amount of physical work required to produce it (i.e. the colouring in) makes a particular kind of impact on the viewer. In contrast to this the covering of the forest area is patchy with a combination of colouring pencil and marker pen. Where colouring pencil has been used the grainy texture of the sugar paper is apparent. The meanings that perception of these different textures may evoke in the viewer are less likely to be conventionally articulated. As such they evoke an affective rather than a cognitive response.

8.3.7 Action

Action, the use of bodily gestures and interactions with physical objects to create meaning, is used extensively in the filtration representations in science. As discussed earlier, action often operates in conjunction with verbal representation (speech) as exemplified in the science teacher's representations of particles. In his demonstration of filtration the teacher's actions also feature prominently – his choice of bodily position and handling of the filter paper. In choosing not to use the funnel and flask he involves his body more directly in the process – it is his hand, not the funnel which supports the filter paper. In this sense his body replaces the conventional equipment. Likewise the position of his body holding the filter paper and pouring the mixture through it create a vector indicating the movement and direction of the process (fig 6.1).

The students themselves make more extensive use of gesture in the presentation of their model. Being a time based mode, action is particularly suited to the representation of narrative processes – the unfolding of events over time. The students, faced with the impossibility of showing the event of filtration itself, use action in careful coordination with their speech to maintain the continuation of the process – they remove the particles from the filter paper, separate them and place the ones representing solids in the flask (fig 6.1). They not only use bodily action to establish this sense of a time based process, but also to classify the different groups of particles by offering, in a cupped hand, first one group of model particles then the

other (fig 6.2). One further element of the students' use of bodily action as a mode is their co-ordination of movement between the four group members. At the start of the presentation they arranged themselves in the order in which they would act during the presentation. The student responsible for manipulating the model stood in one of the central positions directly behind the model. To her left were the two students responsible for presenting the different particle groups and to her right the student who spoke the concluding words. This arrangement of bodies was in itself planned and meaningful. That the students chose to position themselves behind the desk was also significant. In so doing the table served as a barrier between them and their audience (the rest of the class) providing additional status for the students as the presenters of a science experiment.

Bodily action featured most prominently in relation to the Benin City texts with reference to the topological processes. During both their representational activity and their final presentation the students used their fingers as imaginary people moving around the city (fig 6.8). During their representational work this was done to test out the accuracy of the plan and during their presentation to demonstrate this accuracy to other class members.

Other than this the group of students employed bodily gestures extensively as they communicated their conceptions of the city to each other. In negotiating their representational choices (positions, shapes and colours) students used a range of gestures between themselves – hands upturned to offer suggestions, tapping the table indicating uncertainty, tracing fingers along specific routes, pointing to positions or sweeping hands over general areas. As such bodily gestures, as part of their interactions were important mediators of meaning. In addition to this it should be noted that, for the students, working on the plan was a physical experience, not just a mental one. They moved their bodies around the table to work on different parts of the plan and stood up or sat down depending on how they needed to view it, worked on it with their hands and generally interacted with it in a physical way.

8.4 Modes and Representational Choices

The following tables give a comparative overview from both sets of data of the inter-relationship between modes and representational processes in both the students' texts

and the resource texts. Like the process charting of the previous chapter, the mode mapping here derives from the data as presented in the tracking semiosis grids. It is the occurrence of modes as they appear here that is addressed and it is the texts shown in these grids that are used as examples.

In the following sections the information made available by this mapping of modes will be analysed form two perspectives considered important in understanding how choices of mode relate to the students' learning. Firstly the charts will be looked at in terms of general patterns; the differences in frequency and distribution of choice of modes with reference to representational processes in resource and students' texts in the two subject areas. Secondly the charts will be used to identify particular points where information that was presented in one mode (in the resource texts) was recast by students in another mode. These points will be examined as instances of transduction; the reshaping of information from one mode into another. Questions will then be raised concerning the impact of these transductions on the students' learning.

	Writing	Speech	Visual – spatial	Visual – shape	Colour	Texture	Action
Narrative processes	Worksheet	Teacher's demonstration commentary					Teacher's demonstration
Classificational processes	Worksheet		Whiteboard diagram	Whiteboard diagram	Whiteboard diagram		
Analytical processes	Worksheet	Teacher's demonstration Commentary	Whiteboard diagram	Textbook diagram			Teacher's demonstration

Fig 8.5: Inter-relationship of Modes and Representational Processes (filtration): resource texts

	Writing	Speech	Visual – spatial	Visual – shape	Colour	Texture	Action
Narrative processes		Oral presentation of model	Model - equipment and particles	Model - equipment			Presentation of model
Classificational processes		Oral presentation of model	Model – particles	Model - equipment	Model – particles		Presentation of model particles
Analytical processes			Model – equipment and particles	Model - equipment and particles		Model - particles	

Fig 8.6: Inter-relationship of Modes and Representational Processes (filtration): students' text

	Writing	Speech	Visual – spatial 2D	Visual - shape	Colour	Texture	Action
Classificational processes	Artefact evidence – captions		Chalkboard plan	Chalkboard plan	Artefact evidence – cards		
Analytical processes	Written evidence	Tape recorded oral evidence	Chalkboard plan and artefact evidence	Chalkboard plan and artefact evidence			Teacher's gestures
Symbolic processes	Artefact evidence – Labels	Tape recorded oral evidence					

Fig 8.7: Inter-relationship of Modes and Representational Processes (Benin City): resource texts

	Writing	Speech	Visual – spatial 2D	Visual – shape	Colour	Texture	Action
Classificational processes		Presentation commentary	Presentation text	Presentation text	Presentation text	Presentation text – materials	
Analytical processes		Presentation commentary	Presentation text	Presentation text			Presentation gestures
Symbolic processes	Presentation text - labels			Presentation text	Presentation text	Presentation text - materials	

Fig 8.8: Inter-relationship of Modes and Representational Processes (Benin City): students' text

8.4.1 General Patterns

By mapping the occurrence of modes, patterns became apparent which raise questions concerning the relationship between the modes, what they are used to represent and the text makers themselves.

Firstly, it is immediately apparent that, among the representational processes of the resource texts, a broad spread of modes occurs in both science and history (see fig 8.5 and 8.7). Six different modes were found to be operating in the science resource texts and six to some degree in history. Attention will first be given to the deployment of modes in science. In the case of the resource text representations of filtration, there is frequent revision and revisiting of information in different modes. Although just one scientific process is to be represented, the employment of modes is rich and varied. Such, it would appear, is the nature of science teaching – a finite quantity of canonical information the acquisition of which must be facilitated in as many ways as possible.

School science deals with a limited number of specific phenomena. As such there is a tendency for meaning to be represented in as full a range of modes as possible including less conventionally acknowledged modes such as action, colour and the visual modes. In the case of filtration here, information is duplicated and reinforced in multiple modes to maximise the potential for reception – to make a difficult science phenomenon understandable (see fig 8.5). For example, information about how filtration actually occurs (the narrative process) is represented in no less than three different modes; speech, writing and action. Central to an understanding of the process of filtration, it appears, is also an awareness that the liquid mixture consists of particles. Consequently representations of particles proliferate with different information about them occurring, again, in a range of modes; verbal, visual and actional. There is, arguably, an implicit assumption here that because these representations have been made in every available mode they are somehow definitive and that there should be no further impediments to understanding.

In contrast to the unit of work on filtration, the work on Benin in history sought to develop students' ability to extract meaning from a wide range of pre-existing resources. It follows then, that representations in history were found to occur in a smaller number of representational modes with a weighting towards the conventional

verbal and visual text modes (see fig 8.7). Here, in contrast to the science, several important points of information were presented in one mode only. For example the information that there were nine gateways was only available from the tape recorded speech. Reinforcement of information in more than one mode was not made explicit for it was intended that the students', as part of their learning, should make such connections themselves.

In the unit of work on filtration the resource texts were created for the context in which they were received; educational texts (worksheets, textbook diagrams, teacher talk and demonstrations) designed for the purpose of teaching separation processes. In history, however, the texts from which the students work were predominantly drawn from beyond the educational context. Only the tape recording, diagrams and captions were created for teaching purposes and even these were made in the spirit of re-creating the authenticity of genuine historical sources. For example the tape recording – presented to students as a piece of oral history – is preceded by a few seconds of African drumming and is spoken in a strong Nigerian accent. While the teacher's objective in science may have been to consolidate students' understanding of a scientific process – to install in their minds as precise an appreciation of a real world phenomenon as possible, the objectives of the history teacher were, on the other hand, different and more complex. The teacher's stated objectives for the unit of work on Benin were threefold; to transmit knowledge about the ancient civilization of Benin, to develop the skill of extracting valid evidence from historical sources and also to shape students' attitudes. In history, then, the intention was not to utilise modal affordance to make the information content explicit as it was in science. Here, because of the nature of the learning objectives, the reverse was true. Not surprisingly the relatively small quantity of information in science is reconfigured in many different modes whereas the more extensive history information tends to be represented in disparate, almost monomodal texts.

To summarise, the mapping of modes shows the teaching of filtration (i.e. the resource texts) to be more extensively multimodal, for the reasons outlined above, than those used for teaching about Benin City in History.

Given the above comments on modal distribution in the resource texts it is particularly interesting to make comparisons with the students' own texts. What is immediately apparent from the mode mapping is that there is a marked proliferation of representational modes in history (see fig 8.8). Information that has been received in limited modes has been recast in new ones, in particular colour and texture. This spreading of information across a wider range of modes has also lead to significant reinforcement and duplication of meaning – the classificational processes, for example, are represented in a particularly wide range of modes. That is, the classificatory grouping of palace buildings and ordinary people's houses is not only verbally represented in the students' presentation but is also shown visually through shape, position, colour and texture. This extensive consolidation of information in multiple modes is a direct result of the teacher's instructions – to use information from the resources to create a visual representation. Modal transduction, given that many of the resources were not visual, was an imperative. Students were to be awarded a mark for every piece of accurate information shown on the plan.

In science there was also innovation in the use of modes arising from the students' choice to work in the three dimensional mode and their subsequent employment of texture. Although the range of modes available in the resource texts was already significant, the desire to show *more*, as in the history project, prevailed. As has been commented on, the decision to work in three dimensions was one the students arrived at only after lengthy discussion and one which they sensed was more satisfactory but struggled to explain in the verbal mode.

What has led here, to the modal innovation (the move to three dimensions) is the perceived inadequacy of the modes of representation employed in the written and visual resource texts. Given the implicit assumption that the multiplicity of multimodal representations had already made the process of filtration understandable, this is particularly significant. A two dimensional representation, the students decide, simply will not do; it is not up to the job of representing what they know about filtration and what they want to show. It is in sharpening and refining their understanding of the process that the students see the inadequacy of the two dimensional mode. The move to three dimensions is a direct consequence of their learning. This is reinforced by the fact that although the students were aware of the

limitations of their three dimensional model, they were also satisfied with what they produced – saying, in the post project interview that they were 'quite happy' with their model and expressing definite agreement about the usefulness of the activity for their learning.

Given the proliferation of modes in the students' work in science where the presentation texts were already extensively multimodal, it is not surprising that their work in history so richly exploits such a wide range of modes. The expansion of modal engagement (transduction) appears to correspond closely to learning. In the case of history there was a great deal of representational work to be done. Firstly, the information in the resource texts was deliberately restricted to particular modes by its method of presentation. Each kind of evidence had only been made available, in the presentation lesson, to one group of students and in one mode. Consequently only one student in each group had had experience of the original resource text – others were reliant on that particular students' notes or their verbal accounts – already likely to be modal transductions. This structuring of the task was intended to promote individual note-making skills and effective communicative group work. Further to this, as has been noted, much of the information was available from one source, in one mode only. For example information about the position of the palace was only in the written mode, its shape in the visuals and so on. The work to be done in shaping this modally fragmented information into a coherent visual representation required significant levels of transformation and transduction. There is no doubt that the students' enthusiastic engagement with a range of new modes is what facilitated this process.

At the very heart of the students' work in history, then, were the representational challenges posed by the transduction of information received into the visual modes in which they had been instructed to work. The requirements of the visual mode were such that the students were obliged to develop their conception of the city in a number of important ways. In general terms, allocating positions to represented participants (the palace, the forest, the districts etc) required a conception of the relatedness of these participants. At a more detailed level, the visual representation of each participant required decisions to be made about shape and position. Hence the ditches, which were represented in the written mode as being 'around' the city, appear

in the visual mode in the presentation text as five, small, irregular, brown shapes randomly positioned among the ordinary people's dwellings in the lower part of the plan. A perfectly valid transduction of the written information to the visual mode but one which, the students later realised should have been informed by some spoken information in the tape recorded oral evidence which referred to the need for protection from enemies.

8.4.2 Transduction

Transduction, already prominent in the general patterns observable in the mode mapping, now requires a fuller discussion in its own right. Transduction, as should already be apparent, is the re-casting of information from one mode to another, for example from a verbal (written or speech) mode to a visual mode or vice versa. Where transduction occurs, the information itself is, of necessity, reshaped according to the logics and affordances of the new mode. It is in the process of this reshaping that particular demands are made of the text maker's understanding of what is being represented. In meeting these demands existing knowledge has to be reshaped; new elements of meaning may be added, existing meanings extended or brought in to sharper focus. What the following analysis seeks to do is to pinpoint, with some precision, the changes that have resulted from this kind of transduction in specific areas of the students' work.

It is possible to identify from the mode mapping where representational processes have been transducted from one mode to another. In both units of work, the kind of representations students were instructed to produce were visual. This being the situation, writing was, in neither case, to be relied upon to convey information. In both science and history there are specific examples of transduction of information from the written to the visual mode. The gains and losses incurred by these transductions will be examined here in some detail. With regard to science, the students' three dimensional and actional representation of the narrative process of filtration will be examined in relation to the written representation of the same process in the resource texts i.e. the worksheet. With regard to the history, the visual representation of the analytical processes concerning Benin City's roads will be examined in relation to their representation in the written resource text.

In fig 8.5 it can be seen that representations of the narrative process of filtration occur in three modes in the resource texts: speech, writing and action. The speech and action are the representational modes of the teacher's demonstration. Writing is the mode of the worksheet. In fig 8.6 it can be seen that the students' representation of filtration also utilises the modes of speech and action. These are the representational modes of the presentation of their model to the rest of the class. The written mode, however, does not occur. Instead the visual three dimensional modes are used. Clearly there has been a redistribution of information among the modes. The written mode has disappeared and new modes have been brought in to play. What needs to be considered is the transduction of the written worksheet information to the modes employed by the students.

The following sentences from the worksheet have been discussed in the previous chapters in relation to the tracking of semiosis and the charting of representational processes. Here, however, the focus is on the affordances of the written mode. First it is necessary to establish how this brief written representation of filtration configures the narrative process (see Appendix i). The worksheet consists of two parts; a wordsearch puzzle on the topic of mixtures with a list of nine words in a box to its left. Beneath the puzzle are nine sentences with gaps to be completed with words found in the wordsearch. The only information on the worksheet directly concerned with filtration appears as items number 4 and 7 under the instruction 'Use the words you found to complete the sentences below'. It consists of the following sentence (with gaps):

> *4 You use a filter funnel and paper when you carry out* _____.
>
> *7 The solid left on the filter paper after you have filtered a mixture is called the* _____, *and the liquid part of the mixture that drips through the funnel is called the* _____.

(from the worksheet: Mixtures Word Search, Appendix i)

Sentence 4 speaks, as do other sentences on the worksheet, in terms of scientific conventions in to which the students are to be inducted. It refers, not to the process

directly, but to the equipment requirements for carrying out the process. The subject of the verb is 'you'. Having two possible referents; anyone and the student readers, the word 'you' both establishes the conventions of filtration and implicates the students themselves as practitioners of those conventions.

Sentence number 7 is the longest of the nine on the worksheet and the only one that consists of two clauses. By implication, it casts filtration as the most complex of the separation processes. The use of 'you' is also used in this sentence maintaining the dual function of establishing conventional practice and inducting the students as outlined above. What is particularly at issue here, however, is the configuration of the narrative process afforded by this written representation. As has been noted in earlier chapters, the written mode proves particularly adept at giving the appearance of representing filtration while evading direct reference to the event itself. Its focus is not on how filtration actually happens but on the business of naming the separated substances – the names 'residue' and 'filtrate' which need to be filled in by the students. Thus knowing the correct terminology is presented, along with using the correct equipment, as an important element of doing science. As has been commented on earlier, sentence 7 also deftly evades reference to the actual occurrence of filtration in the way in which it handles time – it works backwards. The sentence begins after filtration and proceeds backwards to an earlier stage – the dripping through of the liquid. It makes no reference to starting the process; to pouring the mixture into the funnel, for example. As well as being able to reorder time through the use of tenses, the written mode is also able to evade the attribution of agency and so avoid the thorny issue of the cause of filtration. The mixture is both acted upon (it is filtered) and then actor (it drips through). Neither of these actions refer precisely to what is done to the liquid during filtration; the word 'filtered' assumes prior knowledge of the process and the second set of action words - 'drips through' - refers to a post-filtration stage of the process. It would not be too extreme to suggest that the written mode here offers little more than a masking of the business of filtration.

In their spoken commentary the students do have recourse to many of the affordances of the writing; they are both verbal modes. As has been discussed in chapter six they too manipulate the attribution of agency in their speech. This is helpful in getting around the difficult issue of what actually causes the filtration. Visually and actionally

the students themselves manage every stage of the process of filtration. Not only do they pour the mixture in to the funnel, they also separate the particles with their hands to show what happens during filtration. This is the point in the presentation where they say, 'As you know we can't really show it'. The visibility of the actional mode forces them to acknowledge the limitations of their representation. Here the mode itself has called them to account.

A further difference between the written representation of filtration and the students' transduction is that they are no longer at liberty to manipulate time. Their spoken commentary has to relate to their other modes of representation; the visual and actional. It cannot start at the end and work backwards; the physical presence of the model requires them to show the events in real time, not abstract time.

In moving from the written mode in their representation of filtration to more visual modes the students encounter a number of representational challenges as has been shown. The manipulation of agency and time to mask and evade meaning is no longer possible.

In fig 8.7 it can be seen that representations of the analytical processes of Benin City occur in six different modes in the resource texts: speech, writing, visual-spatial, visual-shape and to a limited extent action and colour. The mode of speech occurs in the tape recorded oral history account, the mode of writing is the historic written accounts by the European visitors, the visual modes are in the chalkboard plan and artefact evidence and the actional mode is the teacher's gestures of walking in to the city. In the students' representation the speech and action modes do feature in the final presentation however the predominant modes are visual. Writing, importantly, is no longer present. Again there has been a redistribution of information among the modes. The written mode has disappeared and the visual modes have, as a result, been invested with a greater quantity of information. What needs to be considered is the transduction of the written information to the modes employed by the students. In order to focus this analysis, a single element of the analytical representational process will be examined – the topology of the roads in the city.

An account of the development of the students' topological representation of Benin City can be found in the semiotic tracking of 6.8. Here the written visitor's description makes reference to the presence of 'streets'. In this account there are two types of street; the main street (along which the writer moves) and other streets on either side (which he can see). All the streets are referred to as 'broad' and 'straight'. It is from this information alone that the students need to decide how to draw the streets on their own visual representation. As has been noted in the commentary to the tracking, the general principle of access is also presented to the students as a resource. The written text is an account of moving around the city, the artefact evidence drawing depicts a procession moving out of the city and, most explicitly, the teacher says it must be possible to move around the city. She asks, 'Does it make sense when you walk in?'.

The transduction of written to visual information about the roads occurs at an early stage with the drawing of the rough sketch. This was done by student D while working in the written evidence group with the written text available. It shows one broad main street up the middle of the page and four narrower streets leading off it; two on either side. All students working in this evidence group produced very similar sketches. One of the reasons for this uniformity could well be the uncertainty experienced by the students in presenting the written information in a visual form. In particular two key points of information were absent in the written form but were required by the visual mode: the number of 'other' streets and, most importantly, where the streets led to. A group decision appears to have been reached concerning the number of 'other' streets – all students drew four. Concerning the destinations of the respective roads they all lead off the edges of the pages. This, rather conveniently avoids the issue of where the streets may lead to but later becomes unsustainable given the requirement to provide access in and around the city and to produce an exhaustive analytical representation. The written information provides no guidance for the students as to what their drawings of streets should look like other than being straight and broad. Consequently the sketch includes no colour or additional detail. During their work on the final presentation text, however, the difficulty in visually representing these streets emerges as a significant challenge. A considerable proportion of the students' discussions consequently concern the roads. The

following extract, which occurs at an early stage, concerns the unresolvable issue of the number of roads.

B *Why don't we have one road coming this way and one road coming that way?*

A *...think we're having too much roads.*

B *...you need a road to go in to something.*

A *Like how? But no. Did you like have any information that they had more than one road?*

B *I didn't have any information on roads.*

D *Who had information on roads? I never. We got ours from the tape. We were oral. They just said about gateposts.*

In fact it was student A who had seen the only information concerning roads (i.e. the written evidence). She assumes there must be more. This short discussion illustrates the emerging tension between the logics of the visual mode and the teacher's instruction to base the plan on the evidence in the resource texts. The visual mode requires a decision to be reached about the number of roads but this information was not in the evidence. This being the case, the students gradually start to develop their own reasoning in relation to the position of the roads:

A *They should come up from here and then, um, like split, like one of the roads can go to the ivory district on that side and the other one can just join in with the main road.*

D *Who's good at talking? I vote Amena to do the talking.*

B *We didn't add any ditches.*

Student A is thinking aloud here, looking directly at the plan and gesturing over it with her hands. She is not joined in her imaginary mapping out of the roads by any other group member. Student D is preoccupied with the forthcoming presentation and B with the absence of a completely different feature. Nevertheless student A continues verbalising her imaginary plan, increases her use of gesture and finally draws the other students in to a discussion:

A *... the main road near to the river. And then like there's a shop, there's a house de de de de de. There's a shop, there's a house de, de, de, de*

B *But then if we're doing a plan that means to get to the other end you have to go through everything if you draw it like that.*

A *Think of a main road, think about, OK, Romford Road, yeah.*

B *Take the chip shop and the traffic lights on Forest Gate. Now you have to go through all of those things to get to here. You do have other ways from Ham Park or whatever but that's like the main road. That's what I'm thinking.*

Attempts are being made here to provide a rationale for decisions regarding the positioning of the roads. In order to conceptualise this the students draw on their own experience of roads – in particular those that they use to get to school. The 'shops' and 'houses' mentioned by student A may not concern the ancient city of Benin but they do provide her with a useful understanding of what a road is: something that takes you past things towards other things. What the students need to decide is what their roads will go past and what they will have at 'the other end'. This application of a real life experience to the representational task opens up a further consideration; in the student's experience there is generally more than one way of getting from A to B. What are the implications of this new realisation for their plan? At this point the students are, perhaps, overwhelmed by the representational uncertainties and possibilities. The video recording shows them rubbing out pencil marks on the plan. After about a minute the discussion about roads picks up again:

B *Shall we leave those roads then? Because we didn't get any information on it.*

D *No one's got any information. Has anyone actually got any information about roads?*

B *I didn't get any*

D *I swear we had it last week.*

A *Are they going to be like grey or something?*

B *Shall we leave those roads then because we didn't find information?*

A *We can't leave them out. Can't leave them out. Everyone else has got roads.*

Here only student A appears to be commited to including the roads. She, however, has raised another issue; colour. This decision too is a requirement of the visual mode but one for which no information was provided. The decision to use grey is more representative of modern tarmac than a road surface likely to have been present in the original Benin City. At this point in the group work there are a series of interruptions by students from other groups then the discussion resumes.

A *Yeah, but think about it. If there's only going to be one road, how are we going to get to there? If there's going to be no cars or nothing.*

B *Yeah but...*

A *You can't just walk through the stuff.*

A *But if they're an important part of the city and I think as well they probably needed roads for it.*

Here the discussion about roads reaches its least coherent point and the stage at which a plausible rationale really needs to be reached. By this stage the students have reconciled themselves to the fact that they will need to include the roads but that they will need to decide themselves where they will lead to and that they should have an underlying principle on which to base these design decisions. It is student A who finally articulates this principle: roads should lead to important parts of the city. It is a simple enough conclusion but one which has only been reached through considerable mental activity. Consequently the roads in the final presentation text lead to the palace and the different residential districts. Meanwhile, can the students, in meeting the challenge of the transduction be said to have learnt?

The above account of the students' difficulties in representing the roads can entirely be accounted for in terms of cross – modal transduction. The challenges they faced were a direct result of transferring information from the written to the visual mode. In short, information that would have been optional in the written account – the precise number of roads, where they led to, their appearance etc. are not optional in the visual mode. Here the students were required to work with the full range of evidence they had received to make the most plausible design decisions. Among these is the decision to foreground the audience's recognition of the roads over an analytical

representation of what they may have consisted of. Consequently the roads are grey with dashed lines down the middle and are immediately recognisable. They are also a visual reminder of the interface between the students' real life experiences and their perceptions of history.

8.5 Sensory Perception

It has already been suggested that the experience of working in a particular mode can itself shape the relationship between the text producer and what is to be represented; that particular modes promote certain kinds of appreciation or understanding which in themselves need to be considered as part of learning. This can be said because different modes operate through different physical senses according to their materiality (see 8.2.2). What follows here is a brief exploration of how mode shaped students' relationships with what they were representing as a result of their sensory engagement. Examples arising from the mode mapping from both science and history will be discussed.

8.5.1 Physical Work

In both science and history the desire to show, as fully as possible, what they had learnt led the students to engage with new modes of representation not found in the resource texts. One of these 'new' modes makes an appearance in both science and history and as such requires special consideration. Texture, as a mode, is brought into operation both in the analytical processes of the filtration model and in the symbolic and classificational processes of the Benin City plan. Data from the students' representational activity (sound and video recordings) provide clues as to how students came to employ this favoured mode. Of particular interest is the video footage of students at work - on the particles in science and on the colouring of the palace in history.

In science a considerable length of time was spent by the students creating their model particles. This activity involved pinching pieces of cotton wool from the packet, dipping them in paint and placing them in an orderly fashion to dry. During this time students were absorbed in their task (which they later described in the post project interview as 'fun') and engaged with the materials in a physical manner. The experience of handling the small, soft pieces of cotton wool and turning them in to

groups of permanently shaped, colour coded particles seems to have occupied the students in a particular way which both gave them pleasure and consolidated their understanding of what a particles is.

Similarly, in history, a significant amount of time was spent colouring – both with marker pens and crayons – to create the desired textures. Again students were happily absorbed by these physical tasks and completed them to a consistent standard. No patch of colouring on the palace is inferior to another; no area of the forest is less densely textured than another. Students were satisfied with the results they achieved and one can only assume that the feelings evoked by these activities were not unconnected to their appreciation and understanding of the objects being represented.

The students' inclination towards a wider engagement with representational modes can also be accounted for in physical, sensual terms. As has been seen, their engagement with the favoured mode of texture was largely sensual and physical. More extensive engagement of the senses is a direct result of the proliferation of modes in the students' representations in both history and science. When given the opportunity to represent what they know (both about filtration and Benin City) the students responded with most enthusiasm in modes that engaged the senses more fully than the resource texts and well beyond the sensual engagement afforded by the most conventional, predominantly verbal school modes. The connection between physical work and cognitive work, although not explicitly stated, appears to have been important to the students. In the words of student D, when asked during the post project interview if the model making activity was a good way of learning:

> *D* *It's much better than working from text books because that's what we usually do.*

Their account, earlier in the interview, of how they constructed the model flask explains what they understood this more desirable 'work' to consist of:

> *B* *Our filtration model was really difficult to make.*
> *D* *We found it difficult to make because first of all we had to go all over the school to look for the materials and the way, the shape we had to*

get it in we had to use like lots of sellotape because it was hard to keep it in place.

The search for material and the struggle to get the right shape, were direct consequences of choosing the three dimensional mode. The physical work of moving around the school looking for the right material then holding it together in position and sellotaping it (this involved all four students together) was legitimate because it both arose from and reinforced their understanding of what the model needed to be in order to show filtration; transparent and an elongated conical shape. In the students' minds these activities were indeed a valuable part of their learning.

Chapter IX
Concluding Remarks

9.1 Summary of Main Claims

This research sought to apply theories of communication (multimodality and social semiotics) and learning to specific classroom situations and their attendant texts. The intention was, through an excavation-type analysis of the data, to extend understanding of the inter-relationship between multimodal representation and learning. Its claims were two fold: to identify certain generalisable characteristics of that relationship from the data and to demonstrate a workable, transferable methodology. In the light of these aims what follows is a summary of the contribution it is believed this research has made.

9.1.1 Theoretical Contributions

That multimodal representation – resource texts and students' own texts – is inseparable from the business of learning has been well established. Furthermore some steps have been made in characterising the nature of that relationship. Multimodal representations, it has been shown, both shape and are shaped by students' learning. Every act of representation, it has been demonstrated, requires a level of epistemological commitment which can only be arrived at through the development of an individual text maker's ideas. The requirement to configure each representation is, as has been illustrated, a necessity for its realisation. In addition to this, every act of representation has also been shown to involve engagement with representational modes. Such engagement, it is proposed, requires decisions to be made about suitability and fitness to purpose which themselves demand of the text maker a familiarity with and ownership of what is represented. The modal imperatives of the representation are a compulsion for the development of ideas – of learning. Furthermore, engagement with modes through the physical activities of representation has been shown to modify and consolidate understanding of what is represented.

As theoretical contributions, these steps towards a fuller understanding of the relationship between multimodal representation and learning are believed to be

significant in their potential to inform practice in many areas of teaching and learning. At a time when teaching and learning styles are seeking to match the multisensorial engagement of students outside the classroom, and when serious questions are being raised concerning the teaching of science in particular, the findings of this research have a definite contribution to make.

9.1.2 Methodological Contributions

From the outset the successful development of a methodology was proposed as a desirable outcome of this research project. The tools and techniques demonstrated here should be measured in terms of their capacity to expose the relationship between multimodal representation and learning and their wider applicability.

Tracking semioisis was a breakthrough for the researcher in terms of developing a methodology. It emerged only with persistent casting and recasting of the data in a variety of formats. Once created, however, the tool proved invaluable in both organising the data and opening up possibilities for analysis. In achieving this level of focused data organisation the excavation analogy proved inspirational. Now that the methodology of tracking semiosis has been developed and demonstrated it stands as a methodological contribution in its own right – the excavation analogy having, outlived its usefulness.

The attendant methodologies of process charting and mode mapping emerged quite naturally from tracking semiosis and proved an efficient means of exposing patterns and regularities in the data which would otherwise have been unobservable. Their usefulness here is derived from their close relationship to the data as organised in the tracking of semiosis. It is not anticipated that either of these techniques could necessarily stand alone as methodological contributions, their reliability being so closely related to the prior organisation of data. Having said this, the ease with which they emerged as tools from the data which had been tracked suggests that the tracking itself could yield a range of other analytical techniques tailorable to specific research requirements.

9.2 Further Research Issues

The further issues it would be useful to highlight here relate to application of the research methodology as outlined above. Given the narrow, in-depth focus of this research – just two student texts and their origins - there is great scope for wider application of the methodology. Further to this, a case must also be made for the specific findings of this research to inform the practice of educationalists. To this end a number of areas for consideration are suggested below.

9.2.1 Wider Application of the Methodology

It is believed that the methodology employed here has the potential to be applied to any learning situation regardless of age group, cultural setting or curriculum content. Wherever teaching and learning take place texts of all kinds proliferate and whatever their mode or configuration the tracking semiosis methodology could be used to systematically organise these texts as data. With wider usage, however, more technologically advanced methods for recording and transporting spoken texts would need to be developed. Those used for this research were barely adequate for the task but could easily, thanks to digital technology and authoring, be improved.

The idea of applying the methodology demonstrated here as a diagnostic tool is one which the researcher has found particularly interesting. The selection of teachers, classes and students for this research was random – the intention being to gain an understanding of the principles behind the relationship between learning and engagement in representational activity. Using the methodology where there are perceived to be particular successes or problems in learning is likely to prove informative. In these cases the choices of representational configurations and modes, having been made apparent, could inform further analysis of the learning paths of individual students or groups of students.

9.2.2 Application of the Findings

That students learn best when deliberately engaged in representational activity is perhaps the key proposition being made here. The opportunities for learning afforded by transforming and transducting information from one mode to another have, it is hoped, been amply demonstrated. Most importantly it has been shown that where students are faced with representational difficulties (for example the challenges to

their understanding incurred by moving from one mode to another), this is when learning is most likely to occur. The benefits for students' learning of being put in such representationally challenging situations need, no doubt, to be more fully exploited. Moreover, during the research, the students themselves acknowledged the usefulness of these particular representational activities and expressed considerable enjoyment – an important factor at all times but especially where student motivation is an issue.

Finally, having demonstrated how evidence of learning from students' multimodal representations can be obtained, a range of possibilities for assessment of learning have been opened up. Consider, for example, a multimodal model making exercise in science as a replacement for a monomodal verbal (written) test paper. From the evidence gathered here, such an assessment would indeed provide a fuller picture of students' learning. Without doubt the issues raised here pose a significant to challenge to the persistent and widespread practice of monomodal verbal assessment.

Bibliography

Atherton, J.S. (2004). *Teaching and Learning: Theories of Learning* [On-line] UK: Available at: http://www.learningandteaching.info/learning/theories.htm Last accessed: 2nd August 2005.

Bakhtin, M. (1981). *The Dialogic Imagination* Austin: University of Texas Press.

Bakhtin, M. (1986). *Speech genres and other late essays* Austin: University of Texas Press.

Baldry, A., Thibault, P., and O'Halloran, K., (2005). *Multimodal Corpora. MCA, multimodal discourse analysis (MDA), and PDA* Colloquium Abstract for Sydney 2005 ISFC. Available at: http://www.asfla.org.au/isfc2005/abstracts/colloquia_abstracts.pdf Last accessed 9th August 2005.

Baldry, A. and Thibault, P. (2005). *Multimodal Transcription and Text Analysis* London: Equinox

Barthes, R. (1973). *Mythologies* St Albans, Paladin

Barthes, R. (1977). *Elements of Semiology* New York: Hill and Wang

Barthes, R. (1997). *Image, Music, Text* London: Harper Collins

Bernstein, B. (1996). *Pedagogy, Symbolic Control and Identity: theory, research critique* London: Taylor & Francis.

Bourdieu, P. (1977). *Outline of a Theory of Practice* Cambridge: CUP.

Burn, A. and Parker D. (2003). 'Tiger's Big Plan: Multimodality and the Moving Image', in Jewitt, C. and Kress, G. (eds.) *Multimodal Literacy.* New York: Lang

Caldas-Coulthard, C. & Coulthard, M. (eds.) (1996). *Texts and Practices: Readings in Critical Discourse Analysis* New York: Routledge.

Coffin, C. (1997). 'Constructing and Giving Value to the Past', in Martin, J.R. and Christie, F. (eds.) *Genres and Institutions: Social Processes in the Workplace and School* Pinter: London, 196 - 230.

Cope, B and Kalantzis, M (eds.) (1993). *The Power of Literacy: A Genre Approach to Writing* London: Falmer Press

Cope,B. and Kalantzis, M. (eds.) (2000). *Multiliteracies: Literacy learning and the design of social futures.* New York: Routledge.

De Grauwe, S. (2000). 'The cognitivist approach to film in the light of systemic-functional theory: a changing of the guards?' in *Image & Narrative*, No. 1. Available at: http://www.imageandnarrative.be/narratology/sofiedegrauwe.htm. Last accessed 9th August 2005

DfES (2002). *Year 9 Booster Kit: Science* Crown Copyright

Dowling, P. (1999). *Basil Bernstein in Frame: 'Oh dear, is this a structuralist analysis?'* Available at: http://www.ioe.ac.uk/ccs/dowling/kings1999/ Last Accessed: 2nd August 2005

Eco, U. (1976). *A Theory of Semiotics* Bloomington: Indiana University Press.

Equinox (2005). *Linguistics 2005* London: Equinox

Foucault, M. (1977). *Discipline and Punish: the birth of the prison* London: Penguin.

Foucault, M. (1980). *Power/Knowledge* Brighton: Harvester.

Foucault (1989). *The Archaeology of Knowledge* London: Routledge

Froebel, F. (2000). *The Education of Man* Bristol: Thoemmes, P.

Gardner, H. (1993). *Frames of Mind: The theory of multiple intelligences* London: Harper Collins

Geertz, C. (1973). *The Interpretation of Cultures: Selected Essays* New York: Basic Books

Geertz, C. (1983). *Local Knowledge: Further Essays in Interpretive Anthropology* New York: Basic Books

Ghadessy, M. (ed.) (1995). *Thematic development in English texts* London: Pinter

Goffman, E. (1974). *Frame Analysis: An Essay on the Organization of Experience* New York: Harper and Row.

Halliday, M. A. K. (1978). *Language as Social Semiotic* London: Arnold

Halliday, M.A.K. (1985). *An Introduction to Functional Grammar* London: Arnold

Halliday, M. A. K. and Martin, J. R. (1993). *Writing Science: Literacy and Discursive Power* London: Falmer

Hodge, R and Kress, G. (1988). *Social Semiotics* Cambridge: Polity

Jakobson, R. (1973). *Main Trends in the Science of Language* London: Allen and Unwin

Jewitt, C. (2003). 'Computer-Mediated Learning: The Multimodal Construction of Mathematical Entities on Screen' in Jewitt, C. and Kress, G. (eds.) *Multimodal Literacy* New York: Lang

Jewitt, C. and Kress, G. (eds.) (2003). *Multimodal Literacy* New York: Lang

Keefer, D. (1996). Review of 'The Language of Displayed Art' by O'Toole M. in *Journal of Aesthetics and Art Criticism* 54 (2) University of Michagan Press

Kress, G. (1993). 'Against arbitrariness: the social production of the sign as foundational issues in critical discourse analysis' *Discourse and Society* 4 (2) 169-93

Kress, G. and van Leeuwen, T. (1996). *Reading Images: The Grammar of Visual Design* London: Routledge

Kress, G. (1997). *Before Writing: Rethinking the Paths to Literacy* London: Routledge

Kress, G. (1998). *Modes of Representation and Local Epistemologies: The Presentation of Science in Education* London: Institute of Education

Kress, G. and van Leeuwen, T. (2001). *Multimodal Discourse – The Modes and Media of Contemporary Communication* London: Arnold

Kress, G., Jewitt, C., Ogborn, J., and Tsatsarelis, C. (2001). *Multimodal Teaching and Learning: the Rhetorics of the Science Classroom* London: Continuum

Kress,G. (2003). *Literacy in the New Media Age* Routledge: London

Kress, G., Jewitt, C., Bourne, J., Franks, A., Hardcastle, J., Jones, K., Reid, E. (2005). *English in Urban Classrooms: A Multimodal Perspective on Teaching and Learning* London: Routledge Falmer

Kristeva, J. (1980). *Desire in Language: A Semiotic Approach to Literature and Art* New York: Columbia University Press

Lancaster, L. (2003). 'Beginning at the Beginning: How a Young Child Constructs Time Multimodally' in Jewitt, C. and Kress, G. (eds), *Multimodal Literacy.* New York: Lang

Lakoff, G. and Johnson, M. (1980). *Metaphors We Live By* Chicago: University of Chicago Press

Lave, J. and Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation* Cambridge: University of Cambridge Press.

Levi-Strauss, C. (1977). *Structural Anthropology* Harmondsworth: Penguin

Martin, J. and Veel, R. (eds) (1998). *Reading Science: critical and functional perspectives on discourses of science* London: Routledge.

Martin, J. (2002). 'Fair Trade: Negotiating meaning in multimodal texts' in Coppock, P. (ed) *Semiotics of Writing: transdisciplinary perspectives on the technology of writing* Turnhout: Brepols

Matthiessen, C. and Halliday M.A.K. (1997). *Systemic functional grammar: a first step into the theory.* Online. Available at: http://www.ru.ac.za/library/theses/2003/kilpert/ft/appendices.pdf Last accessed 26th October 2005

McIntosh, J. (1999). *Practical Archaeology: How We Know What we Know About the Past.* New York: Checkmark

Myers, G. (1990). *Writing Biology: Texts in the Social Construction of Scientific Knowledge* University of Wisconsin Press

Myers, G. (1992). Textbooks and the Sociology of Scientific Knowledge. *English for Specific Purposes.* 11(1), 3-17.

Norris, S. (2004). *Analyzing Multimodal Interaction: A Methodological Framework.* New York & London: Routledge.

Ogborn, J., Kress, G., Martins, I. and McGillicuddy, K. (1996). *Explaining Science in the Classroom.* Buckingham: Open University Press.

O'Halloran, K. (ed.) (2004 a). *Multimodal Discourse Analysis: Systemic-functional Perspectives.* London / New York: Continuum.

O'Halloran, K. (2004 b). 'On The Effectiveness of Mathematics' in Ventola, E; Cassily, C. and Kaltenbacher, M (eds.) *Perspectives on Multimodality* Amsterdam: John Benjamins.

O'Toole, M. (1994). *The Language of Displayed Art* Leicester: Leicester University Press

Palframan, S. (1999). *Teletubbies: an exploration of multimodality* Unpublished MA coursework, London University Institute of Education

Peirce C. S. (1910). 'Signs and their Objects' from Pierce Edition Project (1998) *The Essential Peirce: Selected Philosophical Writings Vol 2 1893 – 1913*: Indiana University Press

Pestalozzi, J. H. (1894). *How Gertrude Teaches her Children* London: Swan Sonnenschein.

Rogers, C. and Freiberg, H. J. (1993). *Freedom to Learn* New York: Merrill.

Rollnick, M., Jones, B., Perold, H. and Bahr, M. A. (1998). 'Puppets and comics in primary science: the development and evaluation of a pilot multimedia package' in *The International Journal of Science Education* 20 (5), 553-550

Rousseau, J.J. (2000). *Confessions* Oxford: Oxford University Press

Saussure, F. de (1974). *Course in General Linguistics* London: Peter Owen

Skinner, B.F. (1968). *The Technology of Teaching* New York: Appleton-Century-Crofts.

Spindler, G.D. (1982). 'The criteria for a good ethnography of schooling.' In G. Spindler (ed.) *Doing ethnography of schooling*, New York: Holt, Rinehart & Winston. 279-309.

Stocklmayer, S. and Treagust, D (1996). 'Images of electricity: How do novices and experts model electric current?' in *International Journal of Science Education* 18 (1), 163-178

Taber, K. S. and Watts, M. (1996). 'The secret life of the chemical bond: students' anthropomorphic and animistic references to bonding', *International Journal of Science Education*, 18 (5), pp 557-568

Van der Veer, R. and Valsiner, J. (1994). *The Vygotsky Reader* Oxford: Blackwell.

Van Leeuwen, T. (1999). *Speech, Music, Sound* London: Macmillan.

Van Leeuwen, T. (2005). *Introducing Social Semiotics* London: Routledge.

Voloshinov, V. (1986). *Marxism and the Philosophy of Language* Harvard University Press.

Veel, R. and Coffin, C. (1996) 'Learning to think like an Historian: The Language of Secondary School History' in Hasan, R. and Williams, G. (eds.) *Literacy in Society* Longman: London. 191-231.

Ventola, E., Cassily, C. and Kaltenbacher, M (eds) (2004). *Perspectives on Multimodality* Amsterdam: John Benjamins.

Vygotsky, L.S. (1962). *Thought and Language*. Cambridge, MA: MIT Press.

Vygotsky, L.S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Walkerdine, V. (1982). 'From Context to Text: a psychosemiotic approach to abstract thought.' In Beveridge, M. (ed.) *Children Thinking Through Language* London: Arnold.

Wenger, E. (1999). *Communities of Practice: Learning, Meaning and Identity* Cambridge: Cambridge University Press.

Woods, B. (2002). Available at: www.instantmessagingplanet.com/wireless/article.php/976511. Last accessed 9th August 2005.

Wertsch, J.V. (1985). Cultural, Communication, and Cognition: Vygotskian Perspectives Cambridge University Press.

Zammit, K. and Callow, J. (1998). 'Ideology and Technology: A visual and textual analysis of two popular CS-ROM programs'. *Linguistics in Education,* 10 (1) 89 -105